

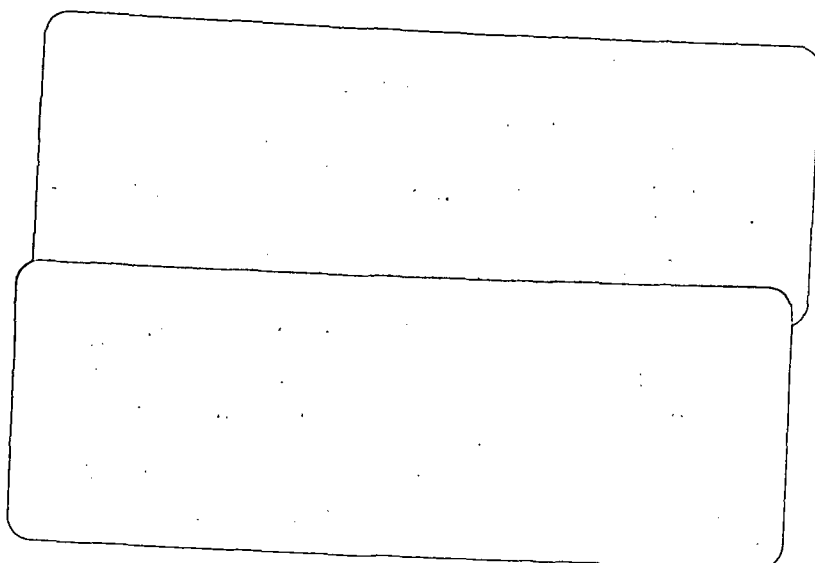
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# Computer Programs for Calculating Pressure Distributions Including Vortex Effects on Supersonic Monoplane or Cruciform Wing- Body-Tail Combinations With Round or Elliptical Bodies

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## SUMMARY

Computer programs have been developed capable of calculating detailed aerodynamic loadings and pressure distributions acting on pitched and rolled supersonic missile configurations which utilize bodies of circular or elliptical cross section. The applicable range in angle of attack is up to  $20^\circ$ . Mach number may range from 1.3 to about 3.0.

The theoretical approach described in this report is based on representing the components by three-dimensional singularities associated with supersonic, linear flow theory. The body with circular cross section is modeled by a distribution along the centerline of supersonic line sources or sinks to account for volume effects and supersonic line doublets to account for effects of angle of attack. If the body cross section is elliptical, supersonic body source panels are placed on the body surface accounting for both volume and angle of attack effects. Constant u-velocity panels are distributed over the lifting fins or wings to account for lift. Fin thickness is modeled by planar source panels. The fins may be arbitrarily deflected. In order to account for fin-body interference, a shell with constant cross section is placed around the body over a length equal to the fin rootchord. Constant u-velocity panels are distributed on this interference shell to account for lift carryover onto the body. Behind the trailing edges, fin-body interference is accounted for by the inclusion of the effects of fin trailing vorticity, determined from slender-body theory, in the calculation of body pressures. Body nose vortex shedding is modeled by potential flow vortices whose strengths and positions in the cross flow plane are determined from an analytical-empirical approach. If the body cross section is circular, the body nose shedding vortex data is built into the main program. For bodies with elliptical cross section, this data is input to the body flow modeling program and must be determined from other means. Body nose and canard fin vortex paths along the configuration are calculated by the



vortex chasing program based on slender-body theory including effects of fin deflection.

Over the body nose section, the calculated pressure distribution can include effects of vorticity shed from the body nose. Through the canard or monoplane wing section, the pressures acting on the body and lifting surfaces can be influenced by the body vortices as they travel along the body. From the canard to the tail section, the body pressures can be affected by body and canard fin vortices. The effects of the vortices may also be included in the calculation of the loads on the tail fins.

A description is given for the procedure required to calculate, in a series of steps, pressure distributions and loadings acting on complete configurations. Two calculative examples are shown. The first case involves a cruciform canard-body with circular cross section-cruciform tail. The second case is concerned with a monoplane wing-elliptical cross section body-interdigitated tail configuration. The computer programs are described and documented in the appendices of this report.

## 1. INTRODUCTION

Methods for computing the supersonic pressure distributions on missiles having monoplane or cruciform fins or missiles with bodies of elliptical cross section are not well developed, and much work is required to produce programs that can be used for design purposes. It is the purpose of the work reported here to extend an existing three-dimensional, supersonic, lifting-surface computer program to include various options required for missiles of the above types. The work was jointly supported by Langley Research Center and the Air Force Flight Dynamics Laboratories. Langley technical directors were Wallace C. Sawyer, Raymond L. Barger, and Jerry M. Allen; Air Force technical director was Calvin L. Dyer.

Before describing the extensions to the preexisting program, a brief description of it will be given. The program was developed under ONR sponsorship and is described in references 1 and 2. In reference 1 supersonic planar or cruciform wing-body combinations with round bodies were treated, and fin loadings were determined using panel methods and linear theory. No vortices were included, and a tandem set of lifting surfaces was not covered. In reference 2 the full Bernoulli pressure equation was used in determining fin loadings. The paths of vortices behind cruciform fins were studied for a cylindrical afterbody using both slender-body theory and the full wave equation. It was decided that slender-body results were sufficiently accurate. Provision to account for specified nose vortices on the fin loading was included. Preliminary leading- and side-edge suction calculations were implemented for the purpose of modeling separation vortices from the leading- and side-edges of the fins using the Polhamus vortex lift analogy described in reference 3. Furthermore, the effects of body nose and canard vortices on the cruciform tail were determined. The applicable range of included angle of attack was increased to about  $20^\circ$ .

The additional scope of the present report covers extensions to the computer program of reference 2 to two missile types, cruciform wing-body combinations with an axisymmetric body and a combination with elliptic body cross sections, monoplane wing and cruciform interdigitated tails. With regard to the first configuration the following items have been added to the computer program:

(1) Add option for determining body nose vortex characteristics explicitly.

(2) Calculate body pressure coefficients for entire missile.

(3) Explicitly determine the positions of all vortices at the canard trailing edge including nose vortices and vortices from canard fin leading edges, side edges, and trailing edges.

(4) Add an option to calculate the trajectories of all vortices over the entire length of the missile.

(5) Include effects of canard and tail fins deflection on vortex paths and fin loadings.

(6) Add option to include effects of canard fin thickness.

With regard to the missile with a body of elliptical cross section, the following tasks are addressed herein:

(1) The three dimensional, supersonic, lifting-surface computer program is to be extended to monoplane wing - combinations for elliptical cross-section missile bodies with cylindrical and boat-tailed aft ends having various conventional wing planform shapes. Pressure distributions shall be calculated including thickness and vortex effects. The resulting forces and moments are to be determined.

(2) The program is to be extended to include provisions for handling a cruciform interdigitated tail that can be located at various cant angles to the body surface. The loads on the tail fins are to be calculated including tail fin-body interference effects together with wing vortex effects. No thickness need be included for the tail fins. The fin contributions to the overall forces and moments are to be determined.

In this report the general approaches are described first for determining the pressure distributions on the two configurational types under consideration. Then a more detailed description of the approach is given with the bulk of the analytical material given in a series of appendices. Next, detailed procedures are given for applying the component computer programs to complete configurations, followed by two calculative examples. Some comparisons between predictions and experiment are then given. Complete descriptions of the component computer programs are given in appendices together with input and output format.

# SYMBOLS EXCLUSIVE OF APPENDICES

a	local body radius
c	chord of a fin panel through its centroid
$c_2$	chord of fin panels at fin side edge
$C_m$   body axis $C_n$   body axis $C_\ell$   body axis	component moments per unit dynamic pressure along $y_B$ , $z_B$ , and $x_B$ due to net effect of $C_N$   panels summed over all body panels
$C_m$   panel $C_n$   panel $C_\ell$   panel	pitching moment, yawing moment, and rolling moment for unit dynamic pressure of single body source panel in $x_B$ , $y_B$ , $z_B$ coordinates
$C_m$   wind axis $C_n$   wind axis	component moments for unit dynamic pressure along $\bar{y}$ , $\bar{z}$ axes due to net effect of $C_N$   panels summed over all body panels
$C_D$	$C_x$   wind axis
$C_L$	$C_N$   wind axis
$C_{x_B}$ , $C_{y_B}$ , $C_{z_B}$	components in $x_B$ , $y_B$ , $z_B$ coordinates of $C_N$   panel summed over all body panels
$C_{x_B}$   panel $C_{y_B}$   panel $C_{z_B}$   panel	components of $C_N$   panel along $x_B$ , $y_B$ , and $z_B$ , respectively
$C_N$   panel	force normal to body panel for unit dynamic pressure, ( $C_p$ ) • (panel area)

SYMBOLS EXCLUSIVE OF APPENDICES (Continued)

$C_x$   wind axis	components in $\bar{x}$ , $\bar{y}$ , $\bar{z}$ coordinates of $C_N$   panels summed over all body panels
$C_z$   wind axis	
$C_z$   wind axis	
$C_{N_{LE}}$	fin normal-force coefficient due to leading-edge suction
$C_{N_{SE}}$	fin normal-force coefficient due to side-edge suction
$C_S$	suction coefficient, suction force divided by $qS_R$
$C_P$	pressure coefficient, $(p-p_\infty)/q$
$C_{P_{min}}$	pressure coefficient for vacuum
$\Delta F_X$	force in $-x_W$ direction acting on lifting vortex element of fin panel
$\Delta F_{Y_1}$	force in $y_W$ direction acting on lifting vortex element of fin panel
$\Delta F_{Y_2}$	force in $y_W$ direction acting on trailing vortices along side edge of a panel for a distance " $c_2$ " between successive trailing vortex element intersections with the edge
GAMT	nondimensional body vortex strength, equation (7)
$K_{LE}, K_{V,LE}$	$C_{N_{LE}}/C_{S_{LE}}$
$K_{SE}, K_{V,SE}$	$C_{N_{SE}}/C_{S_{SE}}$
$M_\infty$	free-stream Mach number

# SYMBOLS EXCLUSIVE OF APPENDICES (Continued)

$n$	summation index for all constant u-velocity panels
NCW	number of fin panels along the chord
NHP	number of constant u-velocity panels on both horizontal fins
NPANLS	sum of panels on horizontal and vertical fins
NRP	number of panels on right horizontal fin
NWBP	total number of panels on cruciform fins and body interference shell
N3P	number of constant u-velocity panels on upper vertical fin and horizontal fins
$p$	load static pressure
$p_{\infty}$	free-stream static pressure
$q, q_{\infty}$	free-stream dynamic pressure
$r_b$	body radius at start of cylindrical section
$S_R$	missile reference area
SUMFT2	see quation (24)
SUMFX	sum of all forces acting upstream on vortex elements of fin in vortex lattice structure nondimensionalized by $qS_R$
SUMFY1	see equation (22)
SUMFY2	see equation (23)

# SYMBOLS EXCLUSIVE OF APPENDICES (Continued)

$u, v, w$	components of the flow velocity along axes $x_B$ , $y_B$ , and $z_B$ , respectively
$u^+$	axial velocity on outward surface of constant u-velocity panel
$\bar{u}, \bar{v}, \bar{w}$	components of velocity $V_R$ along wind axes corresponding to $x_B$ , $y_B$ , and $z_B$ for $\alpha_c = 0$ and $\phi = 0$
$v_N$	velocity normal to body interference panel due to constant u-velocity panels of fins and interference shell
$v_{N_t}$	velocity normal to body interference panel due to fin thickness source panels
$V_R$	total resultant velocity at point on the body surface
$v_W$	velocity induced normal to vertical fin by all constant u-velocity panels of fins and interference shell
$v_{W_i}$	velocity induced normal to vertical fin by body axis singularities and external vortices
$V_\infty$	free-stream velocity
$w_N$	velocity normal to body source panel with orientation angles $\theta$ and $\delta$
$w_W$	velocity induced normal to horizontal fin by all constant u-velocity panels of fins and interference shell
$w_{W_i}$	velocity induced normal to horizontal fin by body axis singularities and external vortices

SYMBOLS EXCLUSIVE OF APPENDICES (Continued)

$\alpha$	angle of pitch, equation (12)
$\alpha_c$	included angle of attack, angle between free-stream velocity vector and body longitudinal axis
$\beta$	angle of sideslip, equation (12)
$\gamma$	ratio of specific heats of air
$\Gamma_B$	strength of right body nose vortex
$\delta$	pitch of panel about $y'$ axis positive in direction $x' \rightarrow z'$
$\delta_{H,L}$	deflection of left horizontal fin, positive trailing edge down
$\delta_{H,R}$	deflection of right horizontal fin, positive trailing edge down
$\delta_{V,D}$	deflection of lower vertical fin, positive trailing edge right
$\delta_{V,U}$	deflection of upper vertical fin, positive trailing edge right
$\theta$	polar angle in $y_B, z_B$ plane
$\theta_s$	streamwise slope of bevelled leading edge of fin
$\theta_{2,BIP}$	angle between trailing edge of body panel and $y_B$ or $y_w$ axis
$v$	index of all control points on cruciform fin and body interference shell
$\phi$	roll angle of missile, positive for clockwise rotation looking toward the nose



# SYMBOLS EXCLUSIVE OF APPENDICES (Continued)

$x_B, y_B, z_B$	Cartesian coordinates fixed to missile with the origin at the body nose tip; $x_B$ is positive rearward, $y_B$ is positive to right looking forward, and $z_B$ is positive upward
$\bar{x}, \bar{y}, \bar{z}$	wind axes corresponding to $x_B, y_B, z_B$ when $\alpha_c = 0, \phi = 0$
$x', y', z'$	set of axes obtained by first rotating $y_B$ and $z_B$ about $x_B$ by angle $\theta$ in positive sense followed by rotating angle $\delta$ about new $y_B$ ( $=y'$ ) axis
$x_{B,V}, y_{B,V}, z_{B,V}$	coordinates of body vortex in $x_B, y_B, z_B$ coordinates
$x_B$	axial distance behind body nose
$x_{B,s}$	distance from body nose to body separation location
$x_{B,TLE}$	value of $x_B$ at leading edge of tail fin root chord
$x_{B,TTE}$	value of $x_B$ at trailing edge of tail fin root chord
$x_{B,WLE}$	value of $x_B$ at leading edge of wing root chord
$x_{B,WTE}$	value of $x_B$ at trailing edge of wing root chord
XST	axial distance parameter, equation (6)
XM, YM, ZM	coordinates of moment center in $x_B, y_B, z_B$ coordinates; YM = 0
$y_V, z_V$	coordinates of right body vortex with $y_V$ measured positive to right of plane of $\alpha_c$ and $z_V$ measured in $\alpha_c$ plane normal to flow direction

## 2. GENERAL APPROACH

### 2.1 Body of Revolution with Cruciform Fins

The basic methods employed to represent an axisymmetric body with cruciform fins have been described in reference 1. The computer program of that reference is based on the wave equation associated with supersonic, linear flow theory. The program models axisymmetric bodies and the fins accounting for mutual interference by the inclusion of an interference panel shell around the body where fins are attached. This program served as the starting point for the determination of the aerodynamic characteristics at higher angles of attack by the inclusion of nonlinear features in the methods initially developed in reference 2. They include the full Bernoulli relationship for the pressure coefficient and the capability to account for specified or hand calculated vorticity shed from the body nose and the fins. In the computer program of reference 2, the body nose vortex strengths and positions for the case at hand were extracted from the experimental data presented in reference 4 and added to the program input.

The present wing-body program, designated DEMON2, incorporates the data for body nose vorticity as a function of axial distance from the nose if the body is circular in cross section. These data, used if the included angle of attack exceeds  $4^\circ$ , are tabulated in this report. The calculation of the vorticity shed from the edges of the fins is now performed by program DEMON2, as described in Appendices B and C. Results include the distribution of vorticity along the leading and side edges, which contribute to one or more concentrated vortices at the trailing edge on each side. A program designated VPATH2, based on slender-body theory, is used to track body nose vortices past the canard section, and to track body nose vortices and canard vortices past the afterbody and tail section for the case involving an axisymmetric body. The fins can have arbitrary deflection. This program serves as a companion to program DEMON2. The crossflow plane solutions are given in Appendix I. For cases involving axisymmetric bodies, program DEMON2 then computes, in a series of steps, the pressures acting on the body surface, fins and the part of the body covered by the interference shell including the effects of body and fin vortices where applicable. A detailed description of the procedure is given subsequently in section 5.1.

## 2.2 Elliptical Body with Monoplane Wing and Interdigitated Fins

For the purpose of handling a body with elliptical cross section, a separate program designated WDYBDY has been developed. This program serves as a companion to program DEMON2 and performs the body-alone modeling when the cross section of the body is elliptical. The method makes use of supersonic body source panels distributed on the surface of the body to account simultaneously for volume and angle of-attack effects. In addition, program DEMON2 has been generalized to treat an interference panel shell with elliptical cross section to which either a monoplane wing or interdigitated tail fins can be attached. The required geometrical transformations and extended flow tangency condition are described in Appendix E. For a body with elliptical cross section, the body nose vorticity characteristics are read in to program WDYBDY and are determined from a separate method since no data base is available as yet. A combined theoretical-empirical computer program for this purpose was developed for the spin-entry studies described in reference 5. This program was specialized to determine the strengths and positions of vortices shed from noses with elliptical cross section at supersonic conditions. For the sake of illustrating the use of the programs, an application of it is included in the second calculative example described later. The vortices are tracked by program VPATHL, based on slender-body theory, past the monoplane wing section and along the body with elliptical cross section up to the tail section if the length of the body is long enough.

For configurations involving bodies with elliptical cross section, program WDYBDY computes the pressures on the body surface up to the forward lifting surfaces (monoplane wing) and between the forward surfaces and tail surfaces (interdigitated tails) including effects of body and wing vortices where applicable. In the monoplane wing and interdigitated tail regions, program DEMON2 determines the pressures on the lifting surfaces and the part of the body covered by the interference panel shell including the effects of vortices where applicable.

By using the above mentioned programs in sequence it is possible to compute the pressure distributions and fin loadings acting on complete configurations by treating first the nose section, then the forward lifting surface section, followed by the afterbody and the tail section.

### 3. DETAILED APPROACH FOR BODIES OF REVOLUTION WITH CRUCIFORM FINS

In this section, the paneling method used to model lifting surfaces and the line singularity distributions used to model axisymmetric bodies will first be summarized. The method used to account for body-fin mutual interference is described. Features added to the boundary condition, to be shown below, include an account for fin thickness and arbitrary fin deflection. The separation vorticity data associated with axisymmetric body noses is tabulated and the pressure calculation method is described.

#### 3.1 Modeling of Fins by Constant u-velocity Panels

Each fin of a cruciform fin-axisymmetric body combination is divided into trapezoidal area panels. The geometrical layout is accomplished by subroutine LAYOUT of program DEMON2. These panels are called constant u-velocity panels for supersonic flow and are located in the chordal planes of the lifting surfaces. When the full Bernoulli equation is used to calculate pressure, these panels are no longer constant pressure panels as referred to by Woodward et al. in reference 6. The solution for a given panel is generated by a superposition of the basic solutions for semi-infinite triangles with their apexes at the panel corners. The basic solution and superposition schemes, as implemented in subroutines VELO and VELNOR of program DEMON2, are described in great detail in sections 3.3.2 through 3.3.6 and Appendix II of reference 7. In addition, the effects of fin thickness are accounted for by the use of constant strength source panels located in the chordal planes of the fins. Their solutions are also obtained by a superposition scheme of semi-infinite triangles as described in section 3.3.4 and Appendix II of reference 7. In program DEMON2, the basic solution and superposition schemes associated with the constant strength source panels for fin thickness are programmed in subroutines VELOTH and THKVEL, respectively.

#### 3.2 Modeling of Body of Revolution Alone

The potential flow model used to represent an axisymmetric body in supersonic flow is described in detail in section 3.2 and Appendix I of reference 7. Such a body can be represented by a distribution of line sources/sinks and line doublets along the body centerline to account for

volume and angle of attack effects, respectively. The strengths of these singularities are determined from the flow tangency condition applied at points on the body surface using a marching procedure from the nose tip to body base. Subroutine BDYGEN of program DEMON2 is concerned with the layout and strength determination of the line singularities. It is possible that a portion of the body nose contour lies outside the Mach cone from its apex at the nose tip. This can occur for high Mach numbers. In this case, the present version of subroutine BDYGEN has been programmed to move the origins of the line singularities up towards the body nose. The result is to minimize the inherent error in the solution near the nose if the Mach cone from the nose tip intersects the body contour. The part of the nose contour outside the Mach cone is then replaced by a cone. This constitutes a limitation to the method. An illustration of this scheme will be discussed later in connection with the pressure distribution on an ogive-cylinder using the Bernoulli pressure expression.

### 3.3 Body Interference Shell for Fin-Body Interference

An interference shell is positioned around the body over the length covered by the fins to account for fin-body interference. Constant u-velocity panels are distributed on this shell by subroutine LAYOUT in addition to those on the fins. The panels on the interference shell and fins contain one control point each, which is located at the 95 percent chord containing the panel centroid. A typical distribution of constant u-velocity panels is shown in figure 1. The body and wing coordinate system,  $(x_B, y_B, z_B)$  and  $(x_W, y_W, z_W)$ , respectively, are also shown. The axial location on the centerline of the origin of the latter is at the axial location of the leading edge of the fin root chords. Both coordinate systems can be the reference coordinate system. Fins in the  $z_W = 0$  or  $z_B = 0$  plane are called horizontal fins. Fins in the  $y_W = 0$  or  $y_B = 0$  plane are called vertical fins. Angle of pitch,  $\alpha$ , and sideslip,  $\beta$ , are determined from the included angle of attack,  $\alpha_c$ , and roll angle  $\phi$ .\*

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\* See equation (12)

### 3.4 Wing-Body Interference Solution

For the cruciform fin-axisymmetric body combination shown in figure 1, the strengths of the line singularities representing the body itself are solved for by subroutine BDYGEN in program DEMON2. Body on fin interference is accounted for as follows. The velocities normal to the fins at the control points induced by the body line singularities are computed by subroutine VELCAL in program DEMON2. On the horizontal fins these velocities are added to the free-stream component normal to the fin surface including the effect of fin deflection. On the vertical fins, the body induced normal velocity is added to the free-stream component normal to the vertical fin surface. These additions are performed in routine CRFWBD of program DEMON2. If external vortices are present, their effects are determined separately by program VPATH2 and added to the body induced velocities by an exchange of data sets between VPATH2 and DEMON2. The flow tangency condition applied to the control points on the horizontal fins is built up in routine CRFWBD of program DEMON2 as follows. Let the number of panels laid out over the cruciform fins and interference shell be NWBP and let NRP be the number of panels on the right horizontal fin only. Then, with  $v$  as index for all the control points and  $n$  the summation index for all the constant  $u$ -velocity panels, the flow tangency condition for the right horizontal fin is given by

$$\sum_{n=1}^{NWBP} w_{w,v,n} = -\sin(\alpha + \delta_{H,R}) - w_{w_i,v}, \quad v = 1, 2, \dots, NRP \quad (1)$$

where  $\alpha$  is the angle of pitch and  $\delta_{H,R}$  is the deflection of the right horizontal fin. The term on the left-hand side represents the summed velocity component (for unit  $V_\infty$ ) normal to the horizontal fin induced by all constant  $u$ -velocity panels on the fins and interference shell of the finned section under consideration. The method for calculating the terms on the left-hand side of equations (1) through (5) is given on page 6 of reference 1 or section 3.3.4 of reference 7. The first term on the right-hand side is due to the free-stream velocity, and the second term  $w_{w_i,v}$  is induced by the body singularities and external vortices if present. Setting NHP equal to the number of constant  $u$ -velocity panels on both horizontal fins, the flow tangency on the left horizontal fin is expressed as

$$\sum_{n=1}^{NWBP} w_{w,v,n} = -\sin(\alpha + \delta_{H,L}) - w_{w_i,v}, \quad v = NRP+1, \dots, NHP \quad (2)$$

where  $\delta_{H,L}$  is the deflection of the left horizontal fin. Let N3P be equal to the number of constant u-velocity panels on the upper vertical fin plus the number on the horizontal fins. The flow tangency condition applied at the control points of the upper vertical fin is written as follows:

$$\sum_{n=1}^{NWBP} v_{w,v,n} = \sin(\beta + \delta_{V,U}) - v_{w_i,v}, \quad v = NHP+1, \dots, N3P \quad (3)$$

Angle  $\beta$  is angle of sideslip and  $\delta_{V,U}$  is the deflection of the upper vertical fin. The term on the left-hand side represents the summed velocity normal to the upper vertical fin induced by all constant u-velocity panels on the fins and interference shell. The first term on the right-hand side is due to the free-stream velocity, and the second term  $v_{w_i,v}$  is induced by the body singularities and external vortices if present. The flow tangency applied at the control points of the lower vertical fin is

$$\sum_{n=1}^{NWBP} v_{w,v,n} = \sin(\beta + \delta_{V,D}) - v_{w_i,v}, \quad v = N3P+1, \dots, NPANLS \quad (4)$$

Here  $\delta_{V,D}$  is the deflection of the lower vertical fin and NPANLS is the sum of the panels on the horizontal and vertical fins.

For cruciform fin-axisymmetric body combination the fins lie in mutually perpendicular planes of symmetry of the cylindrical body (at least for the fins at zero cant angle). Consequently, thickness effects of one fin cannot influence the loading on other fins but they can affect the panels on the interference shell. Therefore, if fin thickness is to be accounted for, the flow tangency condition applied at a control point on the interference shell is now stated as follows:

$$\sum_{n=1}^{NWBP} v_{N,v,n} = -v_{N_t,v}, \quad v = NPANLS+1, \dots, NWBP \quad (5)$$

In this instance, the term on the left-hand side is the summed velocity normal to the body interference panel with index  $v$  induced by the constant u-velocity panels on the fins and the shell itself. The term on the right-hand side is the velocity normal to the  $v^{th}$  body interference

panel induced by all the source panels laid out over the fins to model thickness effects. In this way, fin on body interference is accounted for. Note that vortex induced velocity components are not included in the boundary condition associated with the interference shell, equation (5). The two-dimensional approach used to track vortices past bodies and body-fin combinations already insures that there is no flow through the body surface and fins due to the presence of external vortices. However, to satisfy the fin boundary condition in a three-dimensional sense, the loading on the fins due to the vortices is accounted for on the basis of the panel method from the known vortex paths. Thus, the vortex paths from the leading edge of the cruciform canard on to the tail are first calculated by program VPATH2 on the basis of slender-body theory accounting for the geometry of the configuration. Then, for the axial location of each control point on the fins, subroutine VVELS of program VPATH2 also calculates the velocities at the fin control points induced by the external vortices and their images for the body alone. In this approach, the reaction of the fins to the effect of external velocities comes from two sources. First, the strengths of constant u-velocity are affected by the vortex induced effects in the boundary condition. Second, the pressures calculated subsequently by subroutine SPECPR of program DEMON2 at points on the fins contain all induced velocity components from the external vortices. Further discussion of fin pressures can be found at the end of this description. Pressures as calculated by subroutine BDYPR at the control points of the constant u-velocity panels on the body interference shell also include contributions from the external vortices and their images for the body alone as calculated by program VPATH2.

Equations (1) through (5) form a set of simultaneous equations from which the unknown constant u-velocity panel strengths can be solved. The number of unknown in the set of simultaneous equations is given by NWBP. The matrix solution is performed by subroutines LINEQS and SOLVE in program DEMON2. Constant u-velocity panel strengths are expressed in terms of the axial perturbation velocity component  $\frac{1}{\pi} \frac{u^+}{V_\infty}$ . It has a constant value for all points in the constant u-velocity panel.



### 3.5 Nose Vortex Characteristics

For configurations involving body noses with circular cross section, program DEMON2 is now equipped to determine body nose vortex characteristics up to the cruciform canard section from a data base built into subroutine BDYVTX. The data base is extracted from the compiled experimental data displayed in figure 5 of reference 4. The shed vorticity is represented by two concentrated symmetrical vortices whose strengths and positions in the cross flow plane are given as a function of axial distance from the nose. The separation distance,  $x_{B,s}$ , measured from the nose is obtained from either equation (5), reference 4, for sharp noses or equation (6), reference 4, for noses with cone semi-apex angles in excess of  $30^\circ$ .

The vorticity characteristics are to be determined at some axial distance from the nose,  $x_B$ . The axial location aft of the separation point is nondimensionalized by the body radius at the base of the nose designated RB in subroutine BDYPR. This subroutine calls subroutine BDYVTX and computes the pressure distributions on the body nose (and the portion of the body between the canard and tail fin regions). In subroutine BDYVTX, the nondimensionalized axial distance is multiplied by  $\sin \alpha_c$ , where  $\alpha_c$  is the included angle of attack, and the result is named XPAR. This subroutine then proceeds to interpolate in a table containing a finite set of values for the axial distance parameter called XST.

$$XST = \frac{x_B - x_{B,s}}{r_b} \sin \alpha_c \quad (6)$$

Vortex strengths are designated GAMT and are nondimensionalized by the free-stream velocity  $V_\infty$  and the local body radius,  $a$ , which is a function of axial distance. As a function of the axial parameter XST, the table contains values for GAMT taken off the lower curve of figure 5(a) in reference 4.

$$GAMT = \frac{\Gamma_B}{2\pi a(x_B) V_\infty \sin \alpha_c} \quad (7)$$

This curve contains data for both supersonic and subsonic speeds. The coordinates in the cross flow plane are also divided by the local body radius with  $z_V$  aligned with the component of the free stream in the

cross flow plane and  $y_V$  normal to it, positive to the right. The tables in subroutine BDYVTX contain  $y_V$  coordinates for both subsonic and supersonic flow conditions denoted YA1 and YA2, respectively. The latter is used here. Only one set is given for the  $z_V$  coordinate designated ZA1.

$$\left. \begin{aligned} \text{YA2} &= \frac{y_V}{a(x_B)} \Big|_{\text{supersonic}} \\ \text{ZA1} &= \frac{z_V}{a(x_B)} \end{aligned} \right\} \quad (8)$$

Thus, for a given axial distance from the nose,  $x_B$ , ahead of the forward lifting surface region, the vortex strengths and positions are determined by interpolation from the table shown below.

XST	GAMT	YA2	ZA1
0	0.3	0.63	1.14
1.0	0.32	0.64	1.26
2.0	0.34	0.663	1.38
3.0	0.40	0.665	1.5
4.0	0.48	0.678	1.615
5.0	0.62	0.69	1.73
6.0	0.77	0.70	1.84
7.0	0.90	0.715	1.95
8.0	1.0	0.725	2.05
9.0	1.08	0.735	2.14
10.0	1.15	0.74	2.20

The coordinates  $y_V/a$  and  $z_V/a$  obtained from the above table by interpolation for given  $x_B$  are transformed into the body fixed coordinate system by a rotation through angle of roll  $\phi$ . This process is performed in subroutine BDYPR and it is followed by a call to subroutine VRTVEL to calculate all velocity components induced by the separation vortices at points on the axisymmetric body at axial location  $x_B$ . These velocity components are then combined with the velocity components induced by the line sources/sinks and line doublets of the body of revolution itself for the purpose of determining the pressure distribution, as described below.

### 3.6 Pressure Distribution Calculations

The resultant velocity at a point on the body surface, including effects of free stream, is given by

$$\frac{V_R}{V_\infty} = 1 + \frac{2u}{V_\infty} \cos \alpha_c - \frac{2v}{V_\infty} \sin \alpha_c \sin \phi + \frac{2w}{V_\infty} \sin \alpha_c \cos \phi + \frac{u^2 + v^2 + w^2}{V_\infty^2} \quad (9)$$

where flow angle  $\alpha_c$  is the included angle of attack and  $\phi$  is the angle of roll. This result is obtained by applying the pitch-roll transformation shown in table 1-2 of reference 8 to the velocity components ( $u, v, w$ ) aligned with the body coordinate system ( $x_B, y_B, z_B$ ). The resultant velocity calculated in subroutine BDYPR using equation (9) is then substituted into the Bernoulli pressure-velocity relationship repeated here for convenience.

$$C_P = \frac{p - p_\infty}{q_\infty} = \frac{2}{\gamma M_\infty^2} \left\{ \left[ 1 + \frac{\gamma-1}{2} M_\infty^2 \left( 1 - \frac{V_R^2}{V_\infty^2} \right) \right]^{\frac{\gamma}{\gamma-1}} - 1 \right\} \quad (10)$$

The pressure coefficient has the limiting value corresponding to vacuum pressure ( $p = 0$ ) so that it is equal to

$$C_{P_{\min}} = \frac{-2}{\gamma M_\infty^2} \quad (11)$$

The above pressure calculations at points on the surface of an axisymmetric body are performed by subroutine BDYPR of program DEMON2. For the parts of the body covered by the interference shell, the pressures are calculated by program BDYPR also in the same manner using ENTRY BDYAFT. The resultant velocity calculated by means of equation (9) then includes contributions from the constant  $u$ -velocity panels on the fins and interference shell in addition to the contributions from the body line singularities and external vortices when applicable. Pressures on the fin are also computed with the Bernoulli pressure equation (10). The velocity component contains contributions from the constant  $u$ -velocity panels distributed over the fins and interference shell, contributions from the body singularities and external vortices where applicable. Special care

must be taken in the calculation of the discontinuous velocity components immediately above and below the control points of the constant u-velocity panels on the fins. In subroutine SPECPR of program DEMON2, they are related directly to the strength of the panel under consideration.

Some comparisons with measurements are given in the results comparisons, section 7, for the case of an ogive cylindrical body without body nose vorticity. These comparisons serve to test the body modeling method and the pressure expression used.

In determining the effect of the canard vortices on the pressure distribution, it is first necessary to establish the strength and position at the canard fin trailing edges. This is accomplished as described in Appendices B and C. The vortices are tracked back to the empennage using a vortex tracking program based on slender-body theory. The velocities included in this calculation are described in Appendix I.

#### 4. DETAILED APPROACH FOR ELLIPTICAL BODY WITH MONOPLANE WING AND INTERDIGITATED CRUCIFORM TAIL

This section of the report gives a short description of the method using body source panels to represent a body with elliptical cross sections at combined angle of pitch and sideslip. Extensions to the flow tangency conditions are pointed out. The method used to include effects of specified body nose vorticity is described. The flow angles and the velocity components used in the pressure expression are given. Figure 2 shows a body source panel layout for a body with elliptical cross sections.

##### 4.1 Modeling of Monoplane Wing, Interdigitated Tails and Elliptical Body by Body Source Panels

Basically, the layout of constant u-velocity panels on the monoplane wing or interdigitated tails is performed in the same way as for cruciform fins by subroutine LAYOUT of program DEMON2. For interdigitated tails, additional geometric transformations are required to express panel corner coordinates and induced velocities in the reference coordinate system which can be either the body ( $x_B, y_B, z_B$ ) or wing ( $x_W, y_W, z_W$ ) coordinate system shown in figure 1. These transformations are discussed in Appendix D. At the present time thickness effects are included only for the monoplane wing using planar source panels mentioned earlier in connection with cruciform fins. Program DEMON2 has been extended to allow for an interference shell with elliptical cross section. The

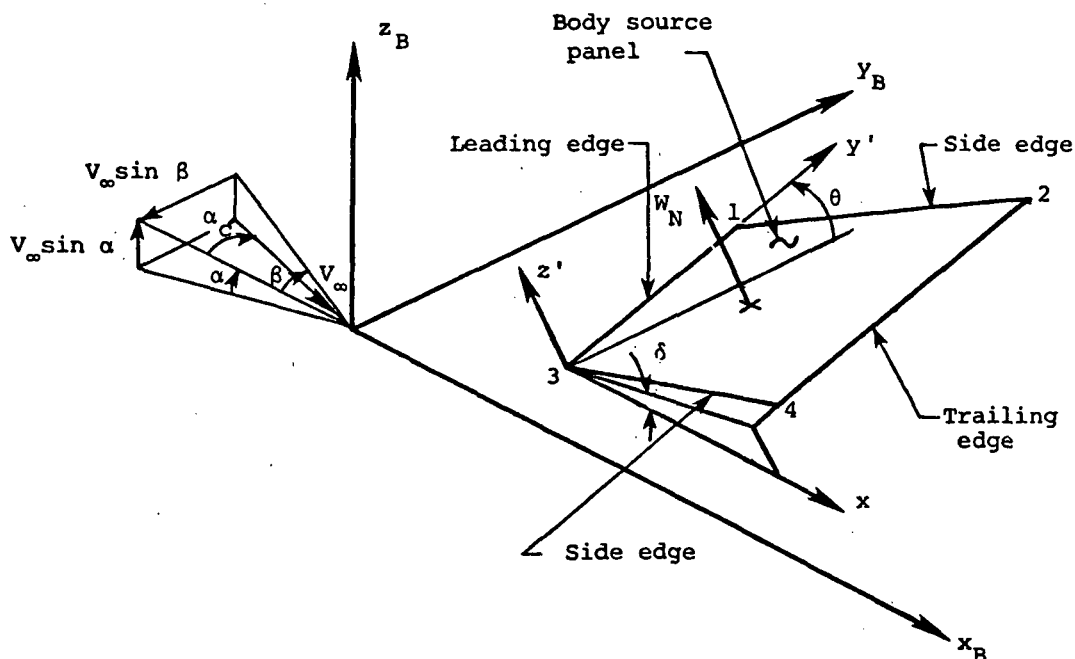
additional analysis required with regard to the load calculation is given in Appendix G concerned with body interference panels on a shell with elliptical cross section. As far as the attitude of a given body interference panel is concerned, the angle between the panel trailing edge and the  $y_B$  or  $y_W$  axis is now calculated in accordance with the expressions for  $\theta_{2,BIP}$  shown in figure 3. This angle is used in the transformation from the body interference panel coordinate system to the wing or body reference coordinate system (and vice versa) as performed by subroutine TRBIPW of program DEMON2.

The body itself with elliptical cross section is modeled by program WDYBDY using supersonic body source panels which can be inclined to the flow. A typical layout of body source panels on a body with elliptical cross section is shown in figure 2. The angle of inclination between a body source panel and the body centerline is limited to the semi-apex angle of the Mach cone associated with the free-stream Mach number. Thus, there is a limit to which body noses can be modeled by the body source panel method. The solution for such a panel is based on supersonic, linear theory as described in reference 9. As is the case for constant u-velocity panels, the influence of one body source panel (not to be mistaken for the planar source panel used to model fin thickness) is also obtained by summing the influences of the four panel corners. The basic expressions for perturbation velocity components are given on page 35 of the cited reference. Program WDYBDY consists of body modeling subroutines extracted from the computer program described in reference 10 and modified to account for combined angles of pitch and sideslip. The subroutines affected by this modification are SOLVE, PRESS, and FORMOM in program WDYBDY. The specific modifications will now be described.

Angle of pitch,  $\alpha$ , and angle of sideslip,  $\beta$ , are related to the included angle of attack,  $\alpha_c$ , and angle of roll,  $\phi$  (positive right fin or wing down), in accordance with the pitch-roll sequence described in reference 8, Table 1-2. As a result, the pitch and sideslip angles are determined from the following expressions.

$$\left. \begin{aligned} \sin \alpha &= \sin \alpha_c \cos \phi \\ \sin \beta &= \sin \alpha_c \sin \phi \end{aligned} \right\} \quad (12)$$

The orientation angles,  $\delta$  and  $\theta$ , associated with an inclined body source panel and the flow angles,  $\alpha$  and  $\beta$ , are shown in the sketch below. Also indicated are the local coordinate systems  $x', y', z'$  associated with the source panel and the reference coordinate system  $x_B, y_B, z_B$ . The orientation angles  $\delta$  and  $\theta$  are shown in their positive sense if the panel corner numbering sequence is as indicated in the sketch. Axis  $x'$  is aligned with  $x_B$ .



In subroutine SOLVE of program WDYBDY, the contribution from the free stream to the flow tangency condition has been modified to include components due to pitch and sideslip. The component from the free stream normal to the body source panel inclined at angle  $\delta$  to the  $x', y'$  plane and inclined to the  $z_B = 0$  plane at angle  $\theta$  is expressed below. This quantity is designated  $W_N/V_\infty$  and is programmed as NB(I) in subroutine SOLVE.

$$\frac{W_N}{V_\infty} = \sin \alpha \cos \theta \cos \delta + \sin \beta \sin \theta \cos \delta - \cos \alpha_c \sin \delta \quad (13)$$

With the contribution from the free stream given by the above equation, the flow tangency condition is applied at the control points (centroids) of the body source panels. The result is a set of simultaneous equations from which the panel strengths are obtained. The matrix solution is an iterative one if the number of source panels is in excess of 60.

#### 4.2 Pressures, Forces, and Moments on Body with Elliptical Cross Section

The pressure coefficient is computed at the body source panel control points by subroutine PRESS in program WDYBDY using the Bernoulli pressure-velocity relationship, equation (10). In subroutine PRESS the resultant velocity  $V_R$  was originally determined from the velocity components in the wind-axis system for the unrolled case. Using the transformations indicated in Table 1-2 of reference 8 for the combined pitch and roll case, the components in the wind-axis system  $(\bar{u}, \bar{v}, \bar{w})$  are related to the components  $(u, v, w)$  aligned with the body axis system  $(x_B, y_B, z_B)$  as follows.

$$\left. \begin{aligned} \frac{\bar{u}}{V_\infty} &= \frac{u}{V_\infty} \cos \alpha_c - \frac{v}{V_\infty} \sin \beta + \frac{w}{V_\infty} \sin \alpha \\ \frac{\bar{v}}{V_\infty} &= \frac{v}{V_\infty} \cos \phi + \frac{w}{V_\infty} \sin \phi \\ \frac{\bar{w}}{V_\infty} &= -\frac{u}{V_\infty} \sin \alpha_c - \frac{v}{V_\infty} \cos \alpha_c \sin \phi + \frac{w}{V_\infty} \cos \alpha_c \cos \phi \\ \frac{V_R^2}{V_\infty^2} &= \left( \frac{\bar{u}}{V_\infty} \right)^2 + \left( \frac{\bar{v}}{V_\infty} \right)^2 + \left( \frac{\bar{w}}{V_\infty} \right)^2 \end{aligned} \right\} \quad (14)$$

The last quantity is denoted Q2 in subroutine PRESS of program WDYBDY. The angles associated with the trigonometric functions are described in connection with equation (12).

In order to add the capability of including effects from specified body nose vorticity in the body pressure calculation, program WDYBDY is equipped with additional subroutines. Subroutine READVX reads in an array of axial locations measured from the body nose, ELBDVT reads arrays containing the lateral coordinates and strengths of the vortices. For the axial location of a given control point in a body source panel, these subroutines interpolate for the coordinates in the cross flow plane and strengths of the vortices. Subroutine VVELS then proceeds to compute the velocity components induced by the set of external vortices and their images inside of an elliptical cross section at the control point. This application of slender-body theory is a degenerate form of one of the

crossflow plane solutions described in Appendix I in connection with vortex path calculations. The flow tangency condition at the body surface is therefore satisfied and the body source panel strengths are not affected. The vortex induced velocities are calculated in the body reference coordinate system and added to the  $v$  and  $w$  velocity components in equation (14). In connection with the application of slender-body theory to elliptical cross sections, a special procedure is followed to avoid numerical problems leading to unrealistic values for the velocity components at the body source panel control points. Essentially, the control points are moved just outside the actual body circumference as described in detail in Appendix H.

Once the pressures on the body are known, subroutine FORMOM, as applied to the body modeling program WDYBDY, computes the overall forces and moments acting on a body with elliptical cross section. This subroutine was extended to include calculating the side force and yawing moment for the pitched and rolled case. First, a normal-force "coefficient" is defined\* for one body source panel as follows.

$$C_N \Big|_{\text{panel}} = - C_p \text{ Area} \Big|_{\text{panel}} \quad (15)$$

By first resolving through the panel inclination angle  $\delta$  and then through the azimuthal orientation angle  $\theta$ , the forces on the panel expressed in the body coordinate system  $(x_B, y_B, z_B)$  indicated in figures 1 and 2 are given by

$$\left. \begin{aligned} C_{x_B} \Big|_{\text{panel}} &= - C_N \Big|_{\text{panel}} \sin \delta \\ C_{y_B} \Big|_{\text{panel}} &= - C_N \Big|_{\text{panel}} \cos \delta \sin \theta \\ C_{z_B} \Big|_{\text{panel}} &= C_N \Big|_{\text{panel}} \cos \delta \cos \theta \end{aligned} \right\} \quad (16)$$

Angles  $\delta$  and  $\theta$  are shown in the sketch discussed above.

The contributions from one body source panel to the moments are determined as follows. The pitching and yawing moments are first calculated in terms of the body coordinate system. In this way, the pitching-moment vector is normal to the  $y_B = 0$  plane and the yawing-moment vector

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\* Normal force per unit dynamic pressure.



is normal to the  $z_B = 0$  plane. Rolling-moment vector lies along the  $x_B$  axis. For one body source panel, the contribution to the pitching-moment coefficient in the body coordinate system is stated below.

$$C_m|_{\text{panel}} = - C_{z_B}|_{\text{panel}} (x_{c,B} - XM) + C_{x_B}|_{\text{panel}} (z_{c,B} - ZM) \quad (17a)$$

nose up positive

The contribution to yawing moment in the body coordinate system is given by

$$C_n|_{\text{panel}} = - C_{y_B}|_{\text{panel}} (x_{c,B} - XM) + C_{x_B}|_{\text{panel}} y_{c,B} , \quad (17b)$$

nose to right positive

and the contribution to rolling moment in the body coordinate system is written as

$$C_l|_{\text{panel}} = - C_{z_B}|_{\text{panel}} y_{c,B} + C_{y_B}|_{\text{panel}} (z_{c,B} - ZM) , \quad (17c)$$

right fin down positive

In the above equations,  $(x_{c,B}, y_{c,B}, z_{c,B})$  are the coordinates of the centroid or control point of the body source panel. The moment center is given by  $(XM, 0, ZM)$  in the body coordinate system. In subroutine FORMOM, the quantities defined by equations (16) and (17) are designated DCXB, DCYB, DCZB and DCMB, DCNYAW, DCLROL, respectively. The contributions to the forces from all the panels are then added and divided by a reference area designated REFA. The contributions to the moments are also added and divided by reference area REFA and reference length REFD.

For the pitched and rolled case, an additional transformation is performed in subroutine FORMOM to finally determine the forces and moments in the wind-axis system. Thus, let  $C_z|_{\text{wind axis}}$  be in the plane formed by the body centerline and the free-stream velocity vector and lie

in the direction normal to that vector. This quality is in fact the lift in coefficient form acting on the body and it is obtained by applying the body to wind axis transformation indicated on page 12 of reference 8.

$$C_L = C_z \Big|_{\text{wind axis}} = -C_{x_B} \sin \alpha_c - C_{y_B} \cos \alpha_c \sin \phi + C_{z_B} \cos \alpha_c \cos \phi \quad (18a)$$

Let  $C_y \Big|_{\text{wind axis}}$  be the force normal to the plane formed by the body centerline and the free-stream vector, positive to the right.

$$C_y \Big|_{\text{wind axis}} = C_{z_B} \sin \phi + C_{y_B} \cos \phi \quad (18b)$$

The axial force in the wind axis system,  $C_x \Big|_{\text{wind axis}}$ , lies along the free-stream vector. It equals the drag-force coefficient  $C_D$ .

$$C_D = C_x \Big|_{\text{wind axis}} = C_{x_B} \cos \alpha_c - C_{y_B} \sin \alpha_c \sin \phi + C_{z_B} \sin \alpha_c \cos \phi \quad (18c)$$

In the wind axis system, the pitching-moment vector is normal to the plane formed by the free-stream vector and the body centerline, positive nose up. The pitch-roll transformation is applied again to the moments in the body axis system.

$$C_m \Big|_{\text{wind axis}} = C_m \Big|_{\text{body axis}} \cos \phi - C_n \Big|_{\text{body axis}} \sin \phi \quad (19a)$$

The yawing-moment vector in the wind axis system lies in the direction of the lift force, positive nose right.

$$C_n \Big|_{\text{wind axis}} = -C_\ell \sin \alpha_c + C_m \Big|_{\text{body axis}} \cos \alpha_c \sin \phi + C_n \Big|_{\text{body axis}} \cos \alpha_c \cos \phi \quad (19b)$$

In equations (18) and (19), angles  $\alpha_c$ ,  $\phi$ ,  $\alpha$  and  $\beta$  are discussed above in connection with equation (12). They are designated ALPHAC, PHIR, ALPHA and BETA, respectively, in subroutines FORMOM, SOLVE and PRESS of program WDYBDY.

### 4.3 Wing-Body and Tail-Body Interference

Once the body with elliptical cross section is modeled by program WDYBDY for given included angle of attack,  $\alpha_c$ , angle of roll,  $\phi$ , and Mach number, the velocity components induced by the body source panels with known strengths are computed at the control points on the monoplane wing or interdigitated tail fins by an added subroutine BDYVEL of program WDYBDY. In this way, body to wing or fin interference is accounted for. This is accomplished by interchanging data sets between programs WDYBDY and DEMON2. Note that for axisymmetric bodies, program DEMON2 performs both the body modeling and fin modeling and no such data set exchange is required.

For the monoplane wing attached to the interference shell, the flow tangency condition for the right wing is given by equation (1). If the configuration is rolled in addition to pitched, the flow tangency condition must also be set up for the left wing, equation (2). The flow tangency condition applied at the control points of the constant u-velocity panels in the interference shell with elliptical cross section is given by equation (5). This boundary condition accounts for wing or fin on body interference. The strengths of the constant u-velocity panels distributed over the monoplane wing and the interference shell with elliptical cross section are then solved from the set of simultaneous equations generated by the flow tangency condition. Effects of external vorticity can be included in the wing boundary condition by exchanging data sets between programs DEMON2 and VPATHL. The latter program determines the paths of the body nose vortices as they pass through the monoplane wing section up to the tail section. It also computes velocity components induced at the control points of the constant u-velocity panels on the monoplane wing by the external (body nose) vortices in the presence of the body only. In this way the monoplane wing is influenced by the external vorticity in the boundary condition and in the calculation of pressures acting on the wing as performed by subroutine SPECPR in program DEMON2. The reason for this procedure is increased accuracy as mentioned in the previous section 3.4 concerned with cruciform fins on an axisymmetric body.

## 5. PROCEDURE FOR APPLICATION OF PROGRAMS TO COMPLETE CONFIGURATIONS

### 5.1 Circular Body with Cruciform Canard and Tail Fins

The following is a description of the step-wise use of programs DEMON2 and VPATH2 for handling a complete configuration with a body of circular cross section. The manner in which the programs are used sequentially and the exchange of data sets are indicated. The first three steps are concerned with the part of the configuration from the body nose to the trailing edge of the canard section. The remaining steps deal with the body aft of the canard and with the cruciform tail-fins. Finally, the procedure required to assemble pressure distributions acting on the entire configuration is given. The steps at which fin forces and moments are calculated are also indicated.

#### 5.1.1 Sequential use of programs

- Step 1(a). Run lifting-surface program DEMON2, with index NCPOUT set equal to 2 in namelist INPUT. This step generates the coordinates of the control points associated with the constant u-velocity panels distributed on the fins of the cruciform-canard and the body-interference shell. The number of control points and the sets of coordinates are stored in a data set designated TAPE4 = CPTS1. There are NWBP sets of coordinates where NWBP is the number of control points on the canard fins and the interference shell. This shell has constant circular cross-sectional area and covers the body from the leading-edge to the trailing-edge of the canard section. This step can be combined with step 1(b) discussed next by setting NCPOUT equal to 1 instead of 2.
- Step 1(b). Consider the canard fins mounted on the body. The body is modeled from its nose to the trailing edge of the canard fin as a minimum. Run lifting-surface program DEMON2 with index NCPOUT set equal to zero in namelist INPUT. This step can be combined with step 1(a) by setting NCPOUT = 1. If the latter value is used, the program not only generates the data set containing the control point characteristics, CPTS1, but will also proceed to compute the pressure distributions on the

body nose up to the canard section. If the included angle of attack is sufficiently high, the effects of body nose vorticity will be accounted for in the body pressures. In addition, the strengths of the constant u-velocity panels and subsequently the pressure distributions and loadings acting on the canard fins and interference shell are calculated without the effects of body nose vorticity. The output includes information concerning fin leading- and side-edge separation vorticity.

Step 2. Vortex path program VPATH2 is now employed to track the body nose vortices over the canard section. Input includes the data set designated CPTS1 containing the number and sets of coordinates of the control points on the cruciform canard fins and interference shell. This data set was generated in either step 1(a) or 1(b). In the input to program VPATH2, indices NCPIN and NVLOUT are set equal to 1 for this run. The former causes data set CPTS1 to be read in and the latter generates a data set designated VELOS1. The input to this program also includes the strengths and coordinates in the crossflow plane of the body nose vortices at the axial station corresponding to the start or leading edge of the canard section. These vortices are tracked back to the end or trailing edge of the canard section. Effects of fin edge vorticity (kept stationary) can be included in the determination of the paths of the body nose vortices. Fin leading- and side-edge vortex strengths (if comparable in magnitude to the body nose vortices) and locations are read-in by the program separately from the input associated with the vortices whose paths and effects are to be calculated.

After the vortex paths have been calculated, program VPATH2 calculates the perturbation velocities induced by the body nose vortices at the control points of the canard fins and interference shell. The velocity components are stored in data set TAPE7 = VELOS1 mentioned earlier. In this velocity calculation, the effects of the vortices are calculated in the presence of the body only, or in other words as if the canard fins are not present.

Step 3. Program DEMON2 is run again with NVLIN = 1 and NCPOUT = 0 in namelist INPUT. The value of the first index tells the program to read in velocity components induced by the body nose vortices at the control points on the canard fins and the interference shell as the vortices pass by the canard section. This information was generated in step 2 by program VPATH2 and stored in data set TAPE7 = VELOS1. The strengths of the constant u-velocity panels are then recalculated including the effects of the external body nose vortices. As a result of this calculation, the pressure distributions, forces and moments on the canard fins and pressures on the body aft of the leading edge of the canard root chord include effects induced by the body nose vortices.

At this stage, the output also contains specifications for the concentrated vortices associated with the fin trailing edges. Specifications calculated on the basis of Bernoulli-type loading pressures will be used in a later step. Furthermore, the distributions of fin leading- and side-edge vorticity calculated on the basis of linear ( $u/V_\infty$  type loading pressure) theory will be considered in the calculations that follow.

Step 4. Program DEMON2 is applied to treat the tail fin section mounted on the body. The body is modeled from the nose to its base. In this step, effects of external vortices are not accounted for. Index NCPOUT = 1, NVLIN = 0 and ITAIL = 1 in namelist INPUT for this run. In addition, quantity XSTART must be set equal to the axial location of the trailing edge of the canard section.

The first index causes the program to generate a data set designated CPTS2 which contains the number and sets of coordinates associated with control points on the tail fins and interference shell. Additionally, this data set contains the sets of coordinates specifying points on the body surface between the canard and tail section at which pressures will be calculated. At this stage, the calculated pressures on the body do not include effects of external vorticity. The tail fin loadings do not include effects of body nose and canard fin vorticity so far.

Step 5.

The vortex path program VPATH2 is now used to chase external vortices from the canard section, along the aft body, past the tail section, to the body base. Index NCPIN = 1 and NVLOUT = 1 for this run. The value given to the first index causes the program to read in data set CPTS2 containing control and body pressure points. Velocity components induced by the external vortices are calculated at the points whose coordinates are in data set CPTS2. The value given to the second index results in the generation of data set TAPE7 = VELOS2 which contains the induced velocity components. The strengths and positions of the vortices at the trailing edge of the canard section as required by the input to program VPATH2 for this run include the following:

1. Body nose vortices whose characteristics are available at the trailing edge of the canard section as a result of step 2 calculated by program VPATH2.
2. Concentrated vortices emanating from the trailing edges of the canard fins. Strengths and locations of these vortices are available from the results (based on Bernoulli pressures) generated by program DEMON2 at the end of step 3.
3. Fin leading- and side-edge separation vortices, if their strengths are comparable to the strengths of the vortices of 1 and 2. Their strengths and spanwise positions (based on linear pressures) at the fin trailing edge are also calculated by and appear in the output of program DEMON2. The user may input a distance off the fin plane equal to the product of the root chord and the tangent of half the angle of attack seen by the fin in question.

After the paths of the above vortices are calculated, program VPATH2 proceeds to compute their effects at points on the aft body and on the tail section as mentioned above. In this process, the velocity components induced by the external vortices are calculated in the presence of the body only, or in other words as if the tail fins are not present.

Step 6. Finally, program DEMON2 is applied again to the tail fins on the body. Index NCPOUT = 0, NVLIN = 1 and ITAIL = 1. The program reads in data set TAPE7 = VELOS2 which contains vortex effects calculated in the previous step at points on the aft body and the tail section including the fins.

The strengths of the constant u-velocity panels are recalculated including the effects of body- and canard-fin vortices. As a result of this calculation, the pressure distributions, forces and moments acting on the tail fins and the pressure distributions on the body from the canard section to the body base are affected by the body and canard fin vortices.

#### 5.1.2 Assembly of pressure, force and moment data

The results obtained in the stepwise manner described above allow for the determination of the pressure distributions on the body and forces and moments acting on the fins as follows.

Nose section:  $0 < x_B < x_{B,WLE}$

At the end of step 1, the output of program DEMON2 includes circumferential pressure distributions at a finite number of axial stations from the nose tip to the leading edge of the canard section. From this information, meridional pressure distributions can also be obtained. Effects of body nose vorticity are accounted for in the velocity components used to compute Bernoulli pressures.

Canard section:  $x_{B,WLE} < x_B < x_{B,WTE}$

Pressure distributions on the body aft of the leading edge of the fin root chords (up to the trailing edge) and on the fins are calculated by program DEMON2 in step 3. The results include effects of body nose vorticity. Normal forces and moments acting on the fins including the influence of body nose vorticity are also calculated and output by the program (refer to quantities under Bernoulli-type loading pressures). Any augmentation to the fin normal force due to fin leading- and side-edge separation can be determined from the following hand calculation



using the quantities printed under the U/VINF (linear) type loading pressure. Consider the right horizontal fin (the other fins are treated the same way).

$$\left. \begin{aligned} C_N|_{LE} + C_N|_{SE} &= K_{LE} C_S|_{LE} + K_{SE} C_S|_{SE} \quad (\text{Polhamus' Analogy}) \\ \text{If } K_{LE} \text{ and } K_{SE} \text{ are not input, then the following} \\ \text{values are used in obtaining vortex strengths:} \\ K_{LE} &\cong 0.5; K_{SE} \cong 0.5 \quad (\text{default value}) \\ C_S|_{LE} &= [(SUMFX)^2 + (SUMFY1 + SUMFY2)^2]^{\frac{1}{2}} \\ C_S|_{SE} &= SUMFY2 \end{aligned} \right\} \quad (20)$$

In the above SUMFX is the sum of all the forces acting upstream in the plane of the fin. For example, if NRP equals the number of constant u-velocity panels on the right horizontal fin

$$SUMFX|_{\text{Right hor. fin}} = \sum_{n=1}^{NRP} \frac{\Delta F_{x,n}}{q} \quad (21)$$

The axial in-plane force  $\Delta F_x$  for one panel is shown in the second sketch of Appendix C. In-plane side force  $\Delta F_{y1}$  is also indicated and

$$SUMFY1 = \sum_{n=1}^{NRP} \frac{\Delta F_{y1,n}}{q} \quad (22)$$

The in-plane side force  $\Delta F_{y2}$  acting at the outboard aft corner is also shown in the second sketch of Appendix C. For all the panels on the fin except those at the tip chord

$$SUMFY2 = \sum_{n=1}^{NRP-NCW} \frac{\Delta F_{y2,n}}{q} \quad (23)$$

where NCW is the number of panels along the chord. Then by adding the contributions from the panels at the tip

$$\text{SUMFT2} = \sum_{n=\text{NRP}-\text{NCW}+1}^{\text{NRP}} \frac{\Delta F_{y_2,n}}{q} \quad (24)$$

Section behind canard section:  $x_{B,WTE} < x_B < x_{B,TTE}$

Pressure distributions on the aft body from the canard section up to the tail section are calculated in step 6 using program DEMON2. From the leading edge of the tail section to the trailing edge (assumed to be at the same axial location as the body base), the pressure distributions on the body appear under the heading AFT OF LEADING EDGE OF FIN ROOT CHORDS. Normal forces and moments acting on the tail fins including influence of body nose and canard vorticity are also calculated and printed by the program (refer to quantities under Bernoulli-type loading pressure). Any augmentation to the fin normal force due to fin leading- and side-edge separation can be determined from the hand calculation discussed earlier in connection with the canard fins, equations (20) through (24).

## 5.2 Elliptic Cross Section Body-Monoplane Wing-Interdigitated Tail Fins

The following is a description of the stepwise use of programs DEMON2, WDYBDY and VPATHL for handling a complete configuration with a body of elliptical cross section. The manner in which the programs are used sequentially and the exchange of data sets are indicated. The first five steps are concerned with the part of the configuration from the body nose to the trailing edge of the monoplane wing. The remaining steps deal with the body aft of the monoplane wing section and with the tail fins. Finally, the procedure required to assemble pressure distributions and overall forces and moments acting on the entire configuration is indicated.

### 5.2.1 Sequential use of program

Step 1. Run lifting-surface program DEMON2 with index NCPOUT = 2 in namelist INPUT. This run generates the coordinates of the control points associated with the constant u-velocity panels

distributed on the monoplane-wing and the body-interference shell. The number of control points and the sets of coordinates are stored in a data-set designated TAPE4 = WCPTS. There are NWBP coordinates where NWBP equals the number of control points on the monoplane wing and the interference shell. This shell has constant elliptical cross section and covers the body from the leading edge to the trailing edge of the monoplane wing.

- Step 2. Run body source panel program WDYBDY for the elliptical body alone with index NCWPT = NWBP in the input. This causes the data set containing control point coordinates designated TAPE4 = WCPTS to be read in. The body length should extend at least up to the trailing edge of the monoplane wing if the trailing edge is supersonic. If this edge is subsonic, the body length should extend past the monoplane wing section in order to account fully for body-wing interference. This program can also read in forebody separation vorticity characteristics calculated by a separate program mentioned in section 2 entitled GENERAL APPROACH. Results of this run include pressure distributions along body meridians up to the wing section including effects of body nose vorticity if applicable. In addition, perturbation velocities induced by body source panels alone at the specified control points are calculated. These velocities are stored in another data set designated TAPE4 = WVELS and passed to program DEMON2.
- Step 3. Program DEMON2 is run again for the monoplane wing/elliptical interference shell with NCPOUT = 0 and NVLIN = 0 in the name-list INPUT. The program proceeds to calculate the constant u-velocity panel strengths including the effects induced by the body source panels. Output includes the strength and lateral positions of the leading- and side-edge vorticity associated with the monoplane wing as a function of axial location. So far, effects of body nose vortices have not been included.
- Step 4. Run program VPATHL with indices NVLOUT = 1 and NCPIN = 1 in the input. It is applied to the monoplane wing/elliptical cross section body. The axial starting point is at the leading edge of the monoplane wing rootchord. Vortices to be

tracked to the trailing edge are the body nose vortices whose strengths and positions are known at the leading edge of the monoplane wing root chord from results obtained with a separate program. The effects of wing leading- and side-edge vorticity (kept stationary) can be included in the calculation of the paths of the body nose vortices. The values given to the indices NCP and NCPIN causes program VPATHL to read in data set TAPE4 = WCPTS containing coordinates of the control points distributed on the monoplane wing and interference shell. After the body nose vortex paths have been calculated, perturbation velocities induced by the body nose vortices at the control points are computed and stored in data set TAPE7 = VRTVEL. In this velocity calculation, the effects of the vortices are calculated in the presence of the elliptical body only.

**Step 5.** Use program DEMON2 again with indices NVLIN = 1 and NCPOUT = 0 in the namelist INPUT. The value of the first index tells the program to read in velocities induced by the body nose vortices at the control points on the wing and interference shell as the vortices pass by the wing section. This information is stored in data set TAPE7 = VRTVEL. The strengths of the constant u-velocity panels are then recalculated including the effects of the external body nose vortices, and the body itself. The output includes pressure distributions on the monoplane wing and the length of body spanned by the wing section accounting for all vortices. In addition, strengths and positions of the trailing-edge vorticity of the monoplane wing are calculated from the spanwise load distributions. At this stage, the configuration has been treated from the body nose up to the trailing edge of the monoplane wing section. Strengths and locations of the body nose vortices, wing leading- and side-edge vortices and wing trailing-edge vortices are now known at the end of the wing section.

**Step 6.** If the tail section is located aft of the wing section by some length of body, this and the following step must be taken in order to track body nose and monoplane wing vorticity along the body up to the tail fin section. Program WDYBDY is run for the elliptic body only to generate

coordinates of control points associated with the source panels laid out from the wing section to the tail section. These coordinates are stored in another data set designated TAPE4 = BCPTS, which is passed to program VPATHL.

- Step 7. Program VPATHL is applied again to the elliptical body alone from the wing section to the tail section. If there is no body length between the wing rootchord trailing-edge and the tail fin rootchord leading-edge, this step is omitted. Vortices to be tracked over this length along the body include the body vortices, wing leading- and side-edge vortices and the wing trailing-edge vortices. Strengths and positions of these vortices are known at the monoplane wing trailing-edge location (see steps 4 and 5). Once the vortex paths have been determined, program VPATHL calculates the velocities induced by the vortices at the control points on the body passed through by means of data set TAPE4 = BCPTS generated by step 6. These velocities are to be passed back to program WDYBDY using data set designated TAPE7 = VRTVEB (step 9).
- Step 8. Program DEMON2 is applied to the interdigitated tails to generate the coordinates of the NWBP control points distributed on the fins and the interference shell. Index NCPOUT is set equal to 2 in namelist INPUT and the coordinates are stored in a data set designated TAPE4 = TCPTS. This step is essentially a repeat of step 1 applied to the tail fin in this instance.
- Step 9. The body program WDYBDY is applied to the entire body length of the configuration. Index NCWPT is set equal to NWBP, the number of control points on the tail fin and interference shell. As in step 2, a data set designated TAPE4 = TCPTS containing control points is read in. Velocities induced by the body source panels at the control points are calculated by program WDYBDY. They are stored in a data set designated TAPE4 = TVELS to be passed back to program DEMON2. In addition, by setting index NVLIN = 1 in the input to program WDYBDY, data set TAPE4 = VRTVEB generated in step 7 is read in. It contains velocities induced by external body and wing

vortices. Their effects are included in the calculation of pressure distributions on the body from the wing section trailing edge to the leading edge of the tail fins. If there is no body length between these two stations, no such pressure distributions are calculated.

Step 10. In this final step, program DEMON2 is applied to the interdigitated tail fins with NCPOUT set equal to zero. This index signals the program to read in the body source panel induced velocities stored on data set TAPE4 = TVELS. For any case involving interdigitated fins, set NDRAG equal to zero. Strengths and positions of forebody vorticity, wing leading-, side- and trailing-edge vorticity are known at the leading edge of the tail section as a result of step 7, or 5 if there is no body length separating the wing and tail sections. Their influences are calculated at the tail fin control points assuming that the vortex paths are not disturbed by the presence of the fin surfaces. Pressure distributions are calculated on the fins and the part of the body spanned by the tailfin section. In addition, forces and moments acting on the fins are computed.

#### 5.2.2 Assembly of pressure, force and moment data

The results obtained in the stepwise manner described above allow for the determination of the pressure distributions and overall forces and moments acting on the entire configuration by adding those calculated for the separate sections as follows.

Nose section:  $0 < x_B < x_{B,WLE}$

Pressure distributions along body meridians, normal- and side-force, pitching- and yawing-moment contributions are calculated by program WDYBDY up to the leading-edge of the monoplane wing root chord. This is accomplished by step 2. Forces and moments are referred to the body-axis system with  $x_B$  directed back along the centerline,  $y_B$  to the right along the horizontal semi-axis viewing forward and  $z_B$  upwards along the vertical semi-axis for an elliptical body. In this way, the normal force  $C_z$  points along the positive  $z_B$  direction and side force  $C_y$

in the positive  $y_B$  direction. Pitching moment is measured in the  $y_B = 0$  plane. If the pitching moment acts to bring the nose up in this plane, the sense of this moment is positive. Yawing moment is measured in the  $z_B = 0$  plane. If this moment acts to move the nose into the positive  $y_B$  direction, the sense of this moment is positive.

Canard section:  $x_{B,WLE} < x_B < x_{B,WTE}$

Pressure distributions along body meridians are calculated by program DEMON2 over this body section in step 5. Normal- and side-force, pitching- and yawing-moment contributions from this body section\* and the monoplane wing are also computed as a result of step 5.

Section behind canard section up to tail fins (if applicable):

$x_{B,WTE} < x_B < x_{B,TLE}$

Over this length of body, the pressure distributions along body meridians are calculated by program WDYBDY as part of step 9. Normal- and side-force, pitching- and yawing-moment contributions are also computed. If there is no body length,  $x_{B,WTE} - x_{B,TLE} \leq 0$ , this part of the procedure is not applicable.

Tail section:  $x_{B,TLE} < x_B < x_{B,TTE}$

Over this last body section, pressure distributions along body meridians are calculated by program DEMON2 in step 10. In addition, contributions to the normal- and side-force, pitching- and yawing-moment from this body section\* and the tail fins are also calculated as part of step 10.

In general it is advantageous to let the number of source panels on the body circumference read into program WDYBDY match the number of circumferential constant u-velocity specified in namelist \$INPUT of program DEMON1. In this way, the meridians on which pressures are computed are essentially the same. Reference areas and lengths must be the same in the inputs to programs WDYBDY and DEMON2. Force and moment coefficients calculated for the individual sections of the entire configuration can then be added to obtain overall forces and moments.

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\* Note that force and moment coefficients associated with the interference shell as calculated by program DEMON2 are only representative of lift carryover from the lifting surfaces to the body; refer to Appendix J.

## 6. CALCULATIVE EXAMPLES

In this section, two sample cases will be described. The first concerns a configuration designated  $B_1W_4T_4$  associated with UPWT Project 1126, for which unpublished data was made available by NASA/Langley. This model consists of a cruciform canard and a cruciform tail attached to a body with circular cross section. The second case involves a wind tunnel model consisting of a monoplane wing and interdigitated tail section mounted on a body with elliptical cross section described in reference 11. These models are used in the sample cases to illustrate the use of the computer program described in this report.

For both cases, first the procedures used to determine the effects of body nose vorticity on the forebody pressures are indicated. Second, canard or monoplane loadings are determined including effects of the body nose vorticity. Third, the calculated canard edge vortices and the body nose vortices are tracked back through the tail section for the first sample case. Finally, the tail fin loadings are calculated including effects of all vortices. Special care must be taken in the positioning of the interference shell around a body with elliptical cross section as will be discussed below.

References will be made to the steps listed earlier in section 5. The method used to hand calculate the augmentation to normal force due to wing edge vorticity is indicated in section 6.2.3.

### 6.1 Sample Case 1: Axisymmetric Body-Cruciform Canard-Cruciform Tail Fins

The configuration of a model including a body with circular cross section and an ogive nose is shown in figure 4. The cruciform canard and tail fins are identical and details of the bevelled sections are indicated. Programs DEMON2 and VPATH2 are used to treat this configuration rolled  $45^\circ$  and at included angle of attack of  $14.216^\circ$ . Under these conditions the angle of pitch and sideslip are both equal to  $10^\circ$ . The Mach number is 1.70. Note that there will be no symmetry with respect to the wing-axis system  $x_w, y_w, z_w$  in terms of aerodynamic loading. Thus, all fins must be modeled. However, there will be symmetry in loading with respect to the direction of the free-stream component in the cross-flow plane. In other words, the configuration is in the X-position



relative to that direction. This condition serves as a check on the programs. For example, the loads on the upper vertical and left horizontal fins, indicated in figure 4, must be equal. Likewise, the vortex paths must be symmetrically positioned relative to the free-stream velocity component in the crossflow plane.

#### 6.1.1 Geometry and singularity layout

The following geometrical specifications and singularity distributions will be used for the axisymmetric body and fins. The specified numbers of singularities along the body centerline and on the fins may not be sufficient for precise calculated results but serve to generate this sample case. Refer to figure 4 for geometrical details.

Namelist \$BODY in subroutine BDYGEN of program DEMON2 includes specifications for the body:

number of line sources/sinks and line doublets, NXBODY = 39  
nose length, LNOSE = 7.8  
body length, LBODY = 39.0

The body radius for the cylindrical section, RB, is specified in the following.

Namelist \$INPUT in main routine CRFWBD of program DEMON2 includes specifications for either the canard or the tail fins and the corresponding body interference shell.

rootchord, CRP = CRPV = 3.6  
exposed semi-span, B2 = B2V = 2.34  
leading-edge sweep, SWLEP = SWLEV = 30.0°  
trailing-edge sweep, SWTEP = SWTEV = 0.0°  
number of constant u-velocity panels along a chord, NCW = 3  
number of planar source panels along a chord, NCWT = 8  
number of constant u-velocity panels along the span, MSWR = 5  
(right horizontal fin)  
MSWL = 5  
(left horizontal fin)  
MSWU = 5  
(upper vertical fin)  
MSWD = 5  
(lower vertical fin)

number of planar source panels along the span is specified in  
 subroutine THKIN of program DEMON2, MSWT = 5 for all fins  
 length of body interference shell, BIL = 3.6  
 radius of body interference shell, RB = 1.3  
 number of body interference panels on the circumference  
 (ring), NBDCR = 16  
 number of body interference panel rings, NCWB = 3  
 distance from body nose to leading edge of lifting surface  
 section, XWLE = 19.8 for canard, XWLE = 35.4 for tail

The thickness slopes are read in by subroutine THETIN of program DEMON2  
 and are determined as follows. The layout specified above for the planar  
 source panels is shown by the thin lines superimposed on the fin planform  
 in figure 4. At the centroid of each panel, the streamwise slope is to  
 be specified. If the centroid lies on a bevelled portion of the fin, the  
 streamwise slope equals the slope of the fin surface measured parallel to  
 the fin rootchord. For centroids on the bevelled portion near the  
 leading edge, the streamwise slope is given by

$$\text{THET} = \tan \theta_s = \frac{0.075}{0.6145} = 0.122 \quad (25)$$

On the unbevelled portion, the slope equals zero. Near the trailing  
 edge, the streamwise slope equals

$$\text{THET} = \tan \theta_s = -\frac{0.075}{0.532} = -0.141 \quad (26)$$

Near the side edge, the streamwise slopes are chosen on the basis of the  
 location of the source panel centroid on the fin. The above input  
 parameters will be used in all runs with program DEMON2 described in the  
 procedure for an axisymmetric body configuration, section 5.1.

#### 6.1.2 Body nose vortices, pressure distributions on forebody

In accordance with step 1b described in section 5.1.1, program  
 DEMON2 is run using the input data shown in figure 5. These data include  
 the geometrical specifications and numbers of singularities laid out to  
 represent the body-canard section of the complete configuration. The  
 input data required by program DEMON2 is described in detail in Appendix  
 J. Note that control index NCPOUT must be set equal to 1. The output of  
 this run is shown in figure 6. It includes a printout of the data set,

designated CPTS1, containing the 108 sets of coordinates of the control points distributed over the canard fins and the interference shell. This data set will be used later. The output also includes pressure coefficients as a function of polar angle for 10 axial locations from the body nose. The polar angle is named THETA and is measured positive counter-clockwise from the positive  $y_B$  or  $y_W$  axis. The number of axial stations on the forebody at which the pressures are calculated is equal to one half of the body line singularities up to the canard section. Subroutine BDYVTX of program DEMON2 calculates the separation point to be at  $x_B = 17.2$  inches or at about the fifth axial station. From that location on to the canard section, the shed vorticity is represented by two concentrated vortices growing in strength and moving in the crossflow plane in accordance with the data base built into subroutine BDYVTX.

The pressures acting on the forebody are calculated in subroutine BDYPR using the Bernoulli pressure expression, equation (10) in coefficient form. In terms of  $p/p_\infty$ , where  $p_\infty$  is the free-stream static pressure, the pressures are plotted in figures 7(a) and 7(b) as a function of axial distance  $x_B$  from the body nose for several polar angles. The solid line represents pressures including body vortex effects. Pressures computed without effects of body vorticity are indicated by the crosses. From the onset of the body vortex shedding modeled by two discrete vortices, the Bernoulli pressures include effects induced by the external vortices and their images inside the body. Along the symmetrically located meridians, at  $\theta = 45^\circ$  and  $225^\circ$  on figure 7(a), the effect of the body vortices is to increase the pressures slightly. Note that the pressure distributions along these meridians are identical due to flow symmetry. However, the meridians at  $\theta = 135^\circ$  and  $315^\circ$ , figure 7(b) show no effect from the body vortices. On account of flow symmetry, the vortices and their images inside the body induce zero lateral velocity components along these meridians. Thus, the pressures are not affected by the body nose vortices along these meridians.

At the leading edge of the canard section, the body nose vortices are fully developed. The paths of the vortices as they pass through the canard section will now be determined and the canard fin loadings calculated.

### 6.1.3 Pressures and loads acting on the cruciform canard-body section

The pressures, forces and moments acting on the fins and body covered by the interference shell excluding body nose vortex effects are available in the output of the run performed with program DEMON2 just described. To account for the body vortices requires knowledge of their lateral coordinates as a function of axial distance through the canard region. In accordance with step 2 of the procedure, section 5.1.1, vortex tracking program VPATH2 is now employed to accomplish that task.

In order to improve accuracy, the strengths and positions of the body nose vorticity at the leading edge of the canard section are obtained from figure 5, reference 4, instead of the body pressure output mentioned above. For the last axial station,  $x_B = 18.98$ , at which body pressures are calculated as a result of the previous step, the body vortex strength,  $\Gamma/V_\infty$ , equals 0.71. The canard leading edge is at  $x_B = 19.8$  and the value for the body vortex strength equals 0.8024 in accordance with the cited figure. The lateral positions of the vortices are also determined at the canard leading-edge location. Body nose vortex strengths and lateral coordinates, in the body reference coordinate system, to be read in to program VPATH2 are given in the following table.

$\Gamma/V_\infty$	$y_{B,V}$	$z_{B,V}$	$x_{B,V}$
0.8024	-0.64337	1.8382	19.8
-0.8024	-1.8382	0.64337	19.8

For this run with program VPATH2, indices NCPIN and NVLOUT are set equal to 1. After the vortex paths are calculated, the vortex induced velocities are determined at the control points on the canard fins and the interference shell. In this process, the vortices are in the presence of the body only. The purpose for this approach is described in section 3.4.

The input for program VPATH2 for this run is shown in figure 8. The output is shown in figure 9. It includes the lateral positions, in the body reference coordinate system, of the body nose vortices at the trailing edge of the canard section. They are given in the following table.

$\Gamma/V_\infty$	$y_{B,V}$	$z_{B,V}$	$x_{B,V}$
0.8024	-0.68451	1.9192	23.4
-0.8024	-1.9192	0.68451	23.4

Comparison with the previous table indicates a small amount of lateral movement of the body vortices as they travel through the canard section. The vortices are located symmetrically with respect to the free-stream component in the crossflow plane. The output also shows the vortex induced velocities at the 108 control points associated with the canard fins and interference shell. Control point coordinates and vortex induced velocities are stored in a data set designated VELOS1.

In order to determine the effects of the body nose vortices on the canard section, program DEMON2 is run again in accordance with step 3 of section 5.1.1. The input for this run is the same as shown in figure 5 except for index NVLIN now set equal to 1 and index NCPOUT set equal to its default value 0. The forebody pressures appear unchanged in the output shown in figure 10. Vortex induced velocity components designated VVEL and WVEL are printed out under the heading POINT COORDINATES AND PERTURBATION VELOCITIES CALCULATED BY PROGRAM VPATH2 or VPATHL. These velocity components are included in the boundary conditions, equations (1) through (4), and the strengths of the constant u-velocity panels are recalculated. The pressures calculated at the control points on the fins and interference shell are changed because of the recalculated panel strengths and the inclusion of vortex induced velocities in the Bernoulli pressure determination.

Figures 11(a) and 11(b) show the pressure distributions on the forebody and over the length of the canard section. The latter are taken from program DEMON2 output under the heading AFT OF LEADING EDGE OF FIN ROOTCHORDS. As before, the solid line represents pressures calculated including the body nose vorticity; the crosses are pressures without body vorticity. For the symmetrically located meridians at  $\theta = 56.25^\circ$  and  $\theta = 213.75^\circ$ , the effects of body nose vorticity are negligible over the canard section. Along the symmetrically located meridians at  $\theta = 101.25^\circ$  and  $\theta = 168.75^\circ$ , the effects of the body vorticity are to increase the pressures. The output shown in figure 10 includes loadings for all fins based on linear pressure and Bernoulli pressure. In both cases, due to flow symmetry the loadings on the right horizontal and lower vertical

fins are identical as are the loadings on the upper vertical and left horizontal fins. On the right horizontal fins, figure 12 shows slight effect of the body nose vorticity on the span loading. Due to the closer proximity of the upper vertical fin to the vorticity, the span loading is reduced significantly in the inboard region. In figure 13 the dashed curve (with vortices) exhibits a maximum and drops off in magnitude towards the fin root. In accordance with the analysis in Appendix B, this type of span load distribution gives rise to an inboard and outboard concentrated vortex at the trailing edge of this canard fin. The right horizontal fin does not show any extrema off the root and only one concentrated vortex results at the trailing edge. The leading edges of the fins are supersonic for the Mach number at hand so there is no leading-edge separation vortex in accordance with the analysis in Appendix C. The side edges of the fins give rise to a separation vortex with negligible strength as shown below. Thus, at the trailing edge of the canard section, the strengths and locations of body and canard vortices are assembled for the purpose of determining their paths to the base of the body. Their characteristics are taken from the output of program DEMON2 as a result of step 3, section 5.1.1. The body nose vortex specifications are taken from the output of program VPATH2 as a result of step 2.

$\Gamma/V_\infty$	$y_{B,V}$	$z_{B,V}$	$x_{B,V}$	
0.8024	-0.68451	1.9192	23.4	} body nose vortices
-0.8024	-1.9192	0.68451	↓	
0.94911	3.15424	0.0	23.4	right hor. fin T.E. vortex
0.05844	-2.09688	0.0	↓	inboard } left hor. fin
-0.59187	-3.46609	0.0		outboard } T.E. vortices
-0.05844	0.0	2.09688	↓	inboard } upper vert. fin
0.59187	0.0	3.46609		outboard } T.E. vortices
-0.94911	0.0	-3.15424	↓	lower vert. fin T.E. vortex
0.01491	3.64	~0.0	23.4	right hor. fin S.E. vortex
-0.01797	-3.64	~0.0	↓	left hor. fin S.E. vortex
0.01797	~0.0	3.64		upper vert. fin S.E. vortex
-0.01491	~0.0	-3.64		lower vert. fin S.E. vortex

In this table, the trailing-edge vortex characteristics, GAMMA/VINF and Y.C.G. or Z.C.G., are obtained from the loading output under the heading BERNOULLI TYPE LOADING PRESSURE. The side-edge vortex characteristics, GAMMA,SE/VINF and YBAR or ZBAR, are obtained from the loading output under the heading U/VINF LOADING PRESSURE. The strengths of the side edge vortices are negligible compared to the strengths of the body nose and trailing edge vortices and will not be included in further analysis.

At the top of figure 14, all the vortices excepting the side-edge vortices listed in the above table are shown in position at the canard trailing edge,  $x_B = 23.4$ . They will eventually be tracked down the body through the tail section. However, before determining the vortex paths over the aft body, the body tail section must be dealt with in accordance with step 4 of section 5.1.1. Program DEMON2 is used again to model the body and the cruciform tail fins without accounting for the presence of body nose and canard fin vortices. The input for this run is the same as shown in figure 5 except that the distance from the nose to the tail section, XWLE, is now set equal to 35.4. Also, indices NCPOUT = 1, NVLIN = 0 and ITAIL = 1 in namelist \$INPUT. Quantity XSTART is set equal to the trailing-edge location of the canard section, XSTART = 23.4. With these specifications, the program generates a data set, designated CPTS2, containing 268 sets of coordinates. Of this set, the first 108 sets pertain to the control points on the tail fins and interference shell. The remaining 160 are associated with points on the body aft of the canard section up to the tail section at which pressures will be calculated. The output for this run is not shown. The calculated pressures on the body meridians and the tail fin loadings do not include effects of body nose and canard vortices so far.

#### 6.1.4 Vortex positions at body base, pressure distributions on aft body, tail fin loadings

Using program VPATH2, the vortices shown in the upper part of figure 14 are chased from the trailing edge of the canard section, past the aft body, through the tail section to the body base. In accordance with step 5 in section 5.1.1, the input to program VPATH2 for this run includes index NCPIN = 1 and index NVLOUT = 1. The input for this run is shown in figure 15. Under the influence of the free stream, the mutual interaction between the vortices and the effects of the presence

of the body and tail section, the vortices move as a function of axial distance.

After the vortex paths have been determined, the vortex induced velocity components will be calculated at the 268 sets of coordinates associated with points on the aft body, tail fins and interference shell. Again, in this process the vortices are in the presence of the body only. The output of program VPATH2 is shown in figure 16. The bottom half of figure 14 shows the vortices at the base of the body as taken from the output at the  $x_B = 39.0$  station (x-station no. 26). Comparison with the upper half shows that the body nose vortices did not move nearly as much as the vortices associated with the fins. The output also includes the velocity components induced by the vortices at the set of 268 points read in to the program. The control point coordinates and the induced velocity components are stored in a data set called VELOS2.

As described in the last step 6 of section 5.1.1, program DEMON2 is applied one more time to the tail fins and body. However, in this instance the input to program DEMON2 includes index NVLIN = 1 and ITAIL = 1. The input is shown in figure 17. Vortex induced velocity components are now included in the flow tangency condition applied at the control points distributed over the fins, equations (1) through (14). They are also included in the Bernoulli pressures calculated by sub-routine BDYPR over the aft body and the part of the body covered by the interference shell associated with the tail fins. The output of this run is shown in figure 18. The pressure distributions and forces and moments acting on the tail fins now include effects induced by the body and canard fin vortices.

The pressures calculated along meridians at  $\theta = 11.25^\circ$ ,  $56.25^\circ$  and  $101.25^\circ$  are shown in figure 19. The solid lines are the pressure distributions calculated including vortex effects and the crosses are calculated with vortices absent. The  $11.25^\circ$  and  $101.25^\circ$  meridians are on the suction sides of the right horizontal and upper vertical fins, respectively. Therefore, through the tail section, the pressures on these meridians are lower than the pressures on the  $56.25^\circ$  meridian. In general, over the aft body and through the tail section, the calculated effect of the body nose and canard vortices is to increase the pressures along the meridians shown.



The effect of the presence of vortices on the span loadings acting on the right horizontal and upper vertical fins are shown in figures 20 and 21. The tail fins are identical in geometry to the canard fins. Without vortices, the solid lines indicate that the span loading on the right horizontal and upper vertical fins are practically identical to those on the corresponding canard fins; see figures 12 and 13. However, in the tail region the body nose and canard vortices have larger influence in reducing the loadings on the two fins as shown in the figures by the dashed lines. On account of symmetry about the component of free stream in the crossflow plane, the loadings on the left horizontal fin are reduced to the same extent shown for the upper vertical fin in figure 21. Likewise, the loading on the lower vertical fin is reduced to the same extent indicated in figure 20.

## 6.2 Sample Case 2: Elliptic Cross Section Body-Monoplane Wing-Interdigitated Tails

The configuration of a model including a body with elliptical cross section is shown in figure 22. The body has an ellipticity ratio of 3. A monoplane wing and interdigitated tail fins with bevelled streamwise sections are attached to the body. Programs WDYBDY, DEMON2 and VPATHL are used to analyze this configuration at angle of attack of  $10^\circ$  and zero roll angle. The Mach number is 1.70. Under these conditions, there will be a symmetry plane at  $y_B = 0$  in terms of the aerodynamic loading. Thus, only the right monoplane wing and the right upper and right lower interdigitated tail fins need to be modeled by program DEMON2. For the same reason, only the right half of the body needs to be modeled by source panels by means of program WDYBDY. Any vortices analyzed by program VPATHL will also be symmetrically positioned with respect to the  $y_B = 0$  plane.

### 6.2.1 Geometry and singularity layout

The following geometrical specifications and singularity distributions will be used for the elliptical cross section body with monoplane wing and interdigitated tail fins. The specified numbers of body source panels to model the body and the numbers of chordwise and spanwise constant u-velocity panels to model the wing and tail fins give rise to a sparse layout. As such they may not be sufficient for precise

calculated results but serve to generate this sample case. Refer to figures 22 in connection with input to program WDYBDY and figure 23 in connection with input to program DEMON2 for geometrical details.

The input to program WDYBDY includes the following specifications for the body with elliptic cross section. There will be two sets, depending on which lifting-surface section the effects of the body are to be determined.

Set #1.- Monoplane Wing Section

Body length to be modeled = 25.6 (covers the monoplane wing section)

Number of body source panels on the half circumference or half ring + 1 = KRAD, KRAD = 9 (8 panels/half ring)

Number of body source panels in the axial direction or number of rings + 1 = KFORX, KFORX = 11 (10 panels axially)

Body length over which pressures and loads are to be computed by program WDYBDY, XWLE = 18 (Program DEMON2 covers the winged section).

Set #2 - Interdigitated Tail Section

Body length to be modeled = 28.0 (covers the interdigitated tail section)

Number of body source panels on the half circumference or half ring + 1 = KRAD, KRAD = 9 (8 panels/half ring)

Number of body source panels in the axial direction or number of rings + 1 = KFORX, KFORX = 12 (11 panels axially)

The step for which this data is the partial input, no pressures and loads are computed

The first set will be used for the run with program WDYBDY in accordance with step 2, section 5.2.1, and the second set will be used for the run in accordance with step 9, section 5.2.1. The body source paneling layout associated with both sets is shown in figures 24(a), 24(b) and 24(c) in planview, sideview and cross section, respectively. Note that only the right half of the body will be modeled.

Namelist \$INPUT in main routine CRFWBD of program DEMON2 includes specifications for the lifting surfaces and their associated interference shells. If the body is modeled by means of body source panels, as is the case here, it is important that the entire interference shell be exterior

to the body source panels. If the shell were made to lie partially on the inside of the body outline, some of the control points distributed on the interference shell may lie on the interior side of one or more body source panels. In this case, the velocity components induced by the source panels at those points would be invalid.\* As a consequence, the interference shells are laid out and the monoplane wing is idealized as shown in figure 23. For the monoplane wing attached to its interference shell with elliptic cross section, the input includes the following (refer to figure 23):

rootchord, CRP = 7.55  
exposed semispan, B2 = 1.0935  
leading edge sweep, SWLEP = 75.0°  
trailing edge sweep, SWTEP = 30.016°  
number of constant u-velocity panels along a chord, NCW = 2  
number of planar source panels along a chord, NCWT = 4  
number of constant u-velocity panels along the span, MSWR = 3  
number of planar source panels along the span is specified in  
subroutine THKIN of program DEMON2, MSWT = 3  
length of body interference shell, BIL = 7.55  
horizontal semi-axis of elliptical interference shell, RB =  
3.4641  
vertical semi-axis of elliptical interference shell, RA =  
1.155  
Note: the ellipticity ratio, RB/RA = 3.0  
number of body interference panels on the circumference (ring),  
NBDCR = 16  
number of body interference rings, NCWB = 2  
distance from body nose to monoplane wing section, XWLE = 18.0

The thickness slopes are read in by subroutine THETIN of program DEMON2. They are determined in the manner described for the first sample case, section 6.1.1. Using the detailed streamwise sections available from reference 11, the following streamwise slopes are used. For centroids of planar source panels near the leading edge, the streamwise slope is given by

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\* The solution associated with body source panels, reference 9, is valid only in the plane of the panel and along the outward normal.

$$\text{THET} = \tan \theta_s = \frac{0.125}{2.516} = 0.049692 \quad (27)$$

On the unbevelled portion, the slope equals zero. Near the trailing edge, the streamwise slope equals

$$\text{THET} = \tan \theta_s = -\frac{0.125}{1.5845} = -0.07889 \quad (28)$$

For the upper right and lower right interdigitated tail fins attached to its interference shell, the input includes the following (refer to figure 23). Thickness is not accounted for.

rootchord, CRP = CRPV = 3.6

exposed semispan, B2 = B2V = 3.6

upper right fin { leading-edge sweep (varies with distance along the span),  
VSWLER = 45.0° up to YRT = 2.0  
VSWLER = 14.04° up to YRT = 3.6  
Note: since leading-edge sweep varies, the trailing edge must also be specified as if it varies with distance along the span  
trailing-edge sweep, VSWTER = 0.0 for all YRT

lower right fin { leading-edge sweep (varies with distance along the span),  
VSWLEU = 45.0° up to ZUT = 2.0  
VSWLEU = 14.04° up to ZUT = 3.6  
see note above  
trailing-edge sweep, VSWTEU = 0.0 for all ZUT

number of constant u-velocity panels along a chord, NCW = 2

number of constant u-velocity panels along the span, MSWR = 4  
(upper right fin)

MSWU = 4  
(lower right fin)

length of body interference shell, BIL = 3.6

horizontal semi-axis of elliptical interference shell,

RB = 3.129

vertical semi-axis of elliptical interference shell,

RA = 1.043

Note: the ellipticity ratio, RB/RA = 3.0

number of body interference panels on the circumference (ring),

NBDCR = 16

number of body interference panel rings, NCWB = 2

distance from body nose to tail section,  $XWLE = 24.4$   
angle of the location of the fins on the interference shell  
measured from positive  $y_w$ -axis,  $THETIT = 22.545^\circ$   
dihedral angle of the fins,  $PHIDIH = 30^\circ$

Angles  $THETIT$  and  $PHIDIH$  are also indicated in figure 3. The above sets of input parameters will be used in the runs with programs  $WDYBDY$  and  $DEMON2$  described in the procedure for a body with elliptical cross section, section 5.2.

#### 6.2.2 Body nose vorticity, pressure distributions on forebody

After running program  $DEMON2$  in accordance with step 1, section 5.2.1, to generate data set  $WCPTS$ , program  $WDYBDY$  is then run to model the body with elliptical cross section. The input to program  $WDYBDY$  includes the parameters in the first set described above and index  $NCWPT$  which must be set equal to the sum of all constant  $u$ -velocity panels on the monoplane wing and the interference shell. The length of body, to be modeled for this run, is taken to the trailing edge of the interference shell associated with the monoplane wing. The input for this run is shown in figure 25. For this case, the geometry of the body with elliptical cross section is given in terms of the horizontal semi-axis,  $FUSBY$ , and the vertical semi-axis,  $FUSAZ$ , as a function of axial location  $XFUS$ . Also included are the body nose vorticity characteristics, if indices  $NVTX$  and  $NXVTX$  are nonzero, provided by a separate program; see section 2.2. The axial stations at which this data is to be specified are read in from subroutine  $READVX$  and the lateral locations and strengths of the vortices are read in by subroutine  $ELBDVT$ . The output of this run is given in figure 26. Included in the output are the pressure coefficients designated  $CP$  and printed on the page identified with **\*\*FORMOM\*\***. They are plotted in figures 27(a) and 27(b) from the body nose up to the leading edge of the monoplane wing section.

Figure 27(a) shows pressure distributions on the upper half of the body. The open symbols include effects of body nose vorticity. Pressure distributions without vortex effects are also shown by the solid symbols. In the legend, the first column of symbols are for meridians on which pressures are calculated over the forebody, the second column are for the monoplane wing section and the third for the tail section. For the moment, the forebody only is considered. The pressures shown in

figure 27(a) are below free-stream static pressure. The effects of the specified body nose vortices are to increase the pressures along the  $\theta = 9.07^\circ$  meridian and to decrease the pressures along the  $\theta = 31.41^\circ$  meridian. On the lower half of the body, figure 27(b) shows that the effects of the body vortices are much less. Only one result is shown without vortex effects and there is little difference between the dark and light triangles. The output also includes the contributions from the forebody to the overall forces and moments under the heading TOTAL COEFFICIENTS ON THE BODY FROM XSTART = 0.0 to XWLE = 18.0. In order to improve the accuracy of these contributions, especially with vortex effects, the number of source panels should be larger than used here in this sample case.

Program WDYBDY also computes velocity components, induced by the body source panels only, at the control points distributed over the monoplane wing and interference shell read in by means of data set WCPTS. These velocity components are stored in a data set designated WVELS for later use by program DEMON2.

### 6.2.3 Pressures and loads acting on the monoplane wing-body section

After completing the calculations of pressures and loads acting on the forebody, program DEMON2 is applied to the monoplane wing-body section in accordance with step 3 of section 5.2.1. As a result of this run, the loadings acting on the monoplane wing section are calculated excluding effects of body nose vorticity. The output also includes the strength,  $\Gamma/V_\infty|_{\text{edge}}$ , and lateral position,  $\bar{y}_w$ , of the leading- and side-edge vorticity as a function of axial coordinate  $x_w$ . Values for these characteristics are taken from the loading output under the heading U/VINF TYPE LOADING PRESSURE. Leading-edge vorticity is designated GAMMA,LE/VINF, side-edge vorticity is GAMMA,SE/VINF, and the lateral location appears as YBAR. Along the leading-edge, the axial coordinate is XLE, along the side-edge it is XSE, both are in the wing coordinate system. The values shown in the following table are taken from the output of program DEMON2 for the right monoplane wing half. They are calculated with  $K_{v,LE} = K_{v,SE} = 0.5$  (refer to Appendix C, equation C11, etc.). Note that  $x_w$  is the axial coordinate in the wing coordinate system.

$x_W$	$\bar{y}_W$	$\frac{\Gamma}{V_\infty} \Big _{\text{edge}}$	
0.66148	3.64135	0.27984	} along leading edge
2.01812	3.82511	0.27786	
3.37295	4.03457	0.28634	
4.081	4.34073	0.44937	} along side edge
6.13099	4.40075	0.58150	

Following step 4 of section 5.2.1, the vortex chasing program VPATHL is then employed to determine the paths of the two body nose vortices from the leading edge to the trailing edge of the monoplane wing section. The input for this run is shown in figure 28. Characteristics of the two symmetric body nose vortices at the start of the wing section are specified on the 9th line. Note that these two sets of characteristics are also shown in the input to program WDYBDY indicated in figure 25 at the last axial station associated with the forebody,  $XV = 18.0$ , on the cards marked YVRTX1, ZVRTX1, GAM1, and YVRTX2, ZVRTX2, GAM2, respectively. Also, the characteristics of the symmetric vortices on the opposite side of the plane of symmetry,  $y_B = 0$  plane, must also be input to VPATHL. The starting values of the symmetric body nose vortex strengths and lateral positions are given in the following table with  $x_B$ ,  $y_B$  and  $z_B$  in the body coordinate system.

$x_B$	$y_B$	$z_B$	$\frac{\Gamma}{V_\infty} \Big _{\text{Body nose}}$
18	2.35	1.673	1.52
18	-2.35	1.673	-1.52

The body nose vortex characteristics as a function of distance from the nose were determined by an adapted version of the program associated with reference 5 as mentioned earlier in section 2.2. Although the magnitude of the body nose vortex strength is at least 2.5 times the magnitude of the edge vorticity strength, for illustrative purposes the edge vorticity will be included in the determination of the body nose vortex paths. Thus, the input to program VPATHL shown in figure 28 also includes the edge vorticity specifications listed in the first table above. At this stage, the edge vorticity characteristics are only approximate in that the body nose vortex effects have not been included in the wing loading nor the edge vorticity distribution as calculated in step 3.

After the body nose vortex paths are known and the wing loading recalculated in step 5, described later, the updated edge vorticity distribution should be compared with the one given in the first table. If differences are sufficiently large, the calculations performed by steps 4 and 5 should be repeated until the edge vorticity distribution is converged.

Figure 29 shows the output of program VPATHL. The geometry of the monoplane plane wing in planform appears under the heading FIN GEOMETRY. The specified strengths and lateral coordinates of the leading- and side-edge vorticity as a function of axial distance measured from the body nose also appears on the first page of the output. The horizontal and vertical semi-axes of the body are held constant over the monoplane wing section. In fact, the body nose vortices pass over the idealized monoplane wing attached to the interference shell as indicated in figure 23. At the location corresponding to the trailing edge of the monoplane wing section,  $x_B = 25.5$ , the coordinates in the crossflow plane of the body nose vortices are given below.

$x_B$	$y_B$	$z_B$	$\frac{\Gamma}{V_\infty}$	Body nose
25.5	2.4609	1.8792	1.52	
25.5	-2.4609	1.8792	-1.52	

Comparison with the preceeding table shows that the body nose vortices move upward and outboard by a small amount. If the monoplane edge vorticity is neglected in the calculation of the body nose vortex paths, the results shown in the table below would be generated by program VPATHL. It is seen that for this illustrative example, the body nose vortices move higher but do not move as much outboard when the effects of edge

$x_B$	$y_B$	$z_B$	$\frac{\Gamma}{V_\infty}$	Body nose
25.5	2.4276	1.9509	1.52	
25.5	-2.4276	1.9509	-1.52	

vorticity are not included. In an actual calculation, the characteristics of the leading- and side-edge vorticity must be determined with a larger number of panels than is used in step 3. The last part of the output generated by program VPATHL contains the velocity components induced by



the body nose vortices at the control points of the monoplane wing. These data are stored in data set VRTVEL.

In accordance with step 5 of section 5.2.1, program DEMON2 is run again to obtain the pressures acting on the monoplane wing-body section including effects of body nose vortices. In this run index NVLIN is set equal to 1 thereby causing data set VRTVEL to be read in. The input of program DEMON2 is shown in figure 30 for this run. Output generated by program DEMON2 is shown in figure 31. The last part contains the pressures acting along meridians on the interference shell under the heading AFT OF LEADING EDGE OF FIN ROOTCHORDS. Figures 27(a) and 27(b) include calculated pressures along 4 meridians on the interference shell. They are indicated by the second column of symbols and correspond to axial locations  $x_B = 21.58$  and  $x_B = 25.36$ . These meridians are essentially the same\* as the meridians for which pressures are plotted on the forebody. Over the upper half of the body, figure 27(a), the pressures through the monoplane wing section continue below free stream. Open symbols include effects of body nose vortex effects and the solid symbols are calculated excluding the body nose vortex effects. Along the  $\theta_p = 11.25^\circ$  meridian the effects of the vorticity is to increase the pressure appreciably and along the  $\theta_p = 33.75^\circ$  meridian the pressure is decreased. On the lower half of the body, the results shown on figure 27(b) show little effects from the body nose vorticity including the axial locations at  $x_B = 21.58$  and  $25.36$ .

The span-load distribution associated with the monoplane wing is shown in figure 32. The calculated results include body nose vortex effects. The solid line represents the potential span-load distribution which does not exhibit a maximum off the wing rootchord in contradistinction with the results computed for the cruciform canard of Sample Case 1 shown in figure 13 and discussed in section 6.1. For the indicated Mach number, the leading edge of the monoplane wing lies aft of the Mach cone with its vertex at the leading edge of the rootchord. Therefore, the leading edge is subsonic and the program calculates the suction distribution along that edge. Using the Polhamus vortex-lift analogy with the proportion of the leading edge suction converted to normal force equal

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\* Slight differences in polar angle are due to differences between geometry of body source panel layout and body interference panel layouts.

to 0.5 (refer to Appendix C), the dashed line represents the augmented span loading up to the side edge. The increments added to the potential span loading are obtained from the spanwise distribution  $CS \cdot C / (2 \cdot B)$  for the right wing. They are calculated on the basis of linear pressure loading under the heading U/VINF TYPE LOADING PRESSURE, and must be multiplied by 0.5. The side edge also contributes to the calculated additional normal-force distribution which would be concentrated near the tip but is not shown in figure 32.

The augmentation to the normal-force coefficient for one wing half can be determined by multiplying the suction coefficient  $C_S|_{LE}$  for the leading edge by the appropriate factor  $K_{V,LE}$  and adding it to the suction coefficient for the side edge  $C_S|_{SE}$  multiplied by the appropriate factor  $K_{V,SE}$ . The suction coefficient for the leading edge is proportional to the accumulated quantity CSINT(I) with index I equal to the number of panels in the spanwise direction. This number is equal to the quantity MSWR, specified in the input for program DEMON2, for the right wing half. In other words, the last value under the heading CSINT is taken from the spanwise distributions calculated on the basis of linear pressure loading of the lifting surface under consideration. This value must be multiplied by  $2b$  where  $b$  is twice the exposed semispan,  $b/2$ , specified in the input of program DEMON2 and divided by the reference area  $S_{REF}$ . The suction for the side edge can be obtained from a numerical integration of the quantity SUCTION FORCE PER UNIT LENGTH / ( $Q \cdot TIPCHORD$ ) which appears under the heading SIDE EDGE DISTRIBUTION in the loading output calculated with linear pressure loading. Setting this quantity equal to  $c_{S,JSE}$ , the suction coefficient associated with the side edge is given by

$$C_S|_{side\ edge} = \frac{(c_{TIP})^2}{S_{REF}} \sum_{JSE=1}^{NCW} c_{S,JSE} \cdot \frac{C_{TIP,JSE}}{C_{TIP}} \quad (27)$$

In the above expression,  $c_{TIP}$  is the chord of the side edge or wing tip,  $S_{REF}$  is the reference area and NCW is the number of constant u-velocity panels in the chordwise direction. Thus for one wing half, the augmentation to the normal-force coefficient due to leading- and side-edge vorticity can be computed as follows.

$$C_N|_{\substack{LE+SE \\ vorticity}} = K_{V,LE} C_S|_{LE} + K_{V,SE} C_S|_{SE} \quad (28)$$

The vortex lift factors  $K_{V,LE}$  and  $K_{V,SE}$  are discussed in Appendix C.

The above process for the calculation of the augmentation to normal force due to leading- and side-edge vorticity must be repeated for each wing half. Since the flow conditions (including the presence of body nose vorticity) and configuration geometry are symmetric with respect to the  $y_B = 0$  plane, the resulting loading on the body and lifting surfaces are also symmetric. Thus, the augmentation given by equation (28) must be doubled.

Finally, the updated characteristics of the monoplane wing leading- and side-edge vorticity also appear in the loading output under the heading U/VINF TYPE LOADING PRESSURE. They are listed below and at this stage (step 5) include effects of body nose vorticity. Comparison with the results excluding body nose vorticity shown in the first table of this section indicates an appreciable drop in strength and a slight out-board movement. On the basis of the difference in vorticity strength, an

$x_W$	$\bar{y}_W$	$\frac{\Gamma}{V_\infty}$ edge	
0.66148	3.64135	0.19406	} along leading edge
2.01812	3.83365	0.19763	
3.37295	4.05562	0.21123	
4.081	4.36126	0.35606	} along side edge
6.13099	4.41828	0.47179	

iteration would be recommended for an actual calculation. Note that a drop in edge vorticity strength would result in less influence in the body nose vortex path calculation. This should speed up the convergence mentioned earlier in this section.

#### 6.2.4 Pressures and loads acting on the interdigitated tail-body section

According to figure 23, the monoplane wing-body section actually overlaps the interdigitated tail-body section. Thus, there is no after-body separating the former from the latter. Consequently, steps 6 and 7 described in section 5.2.1 are omitted.

In dealing with the overlap situation, the following approximate procedure is adopted. The strengths and positions of the body nose vortices and the monoplane wing vortices are calculated by the preceding steps 4 and 5. The axial locations at which these characteristics are now known vary a little. The body nose vortices are known at  $x_B = 25.5$ .

The monoplane wing vortices are calculated somewhat aft of this location on or slightly above the trailing edge at different spanwise locations. For the purpose of determining the effects on the interdigitated tails, the vortices are assumed to pass through the tail section in a direction parallel to the body centerline. Their lateral positions are taken from the results obtained earlier. The following table contains the coordinates in the crossflow plane and the strengths of the external vortices influencing the pressures and loads acting on the interdigitated tails and body section. They will be part of the input to program DEMON2 applied

$y_B$	$z_B$	$\frac{\Gamma}{V_\infty}$	
2.4609	1.8792	1.52	} body nose vortices
-2.4609	1.8792	-1.52	
4.41828	0.661	0.47179	} combined LE and SE vorticity at TE of monoplane wing
-4.41828	0.661	-0.47179	
4.38465	0.0	0.59704	} TE vortices on TE of mono- plane wing
-4.38465	0.0	-0.59704	

to the tail section. Note that the strengths and positions of the symmetry vortices must also be specified. The body nose vortex characteristics appear in the output of program VPATHL for the last axial station at  $x_B = 25.5$  as a result of step 4. The combined leading- and side-edge vorticity characteristics at the wing trailing edge are obtained from the output of program DEMON2 as a result of step 5. They are taken from the distribution of vorticity along the side edge under the heading U/VINF TYPE LOADING PRESSURE. The accumulated value of the side-edge vorticity added to the leading-edge vorticity is taken at the wing trailing edge. In other words, the last values in the columns headed YBAR and GAMMA,SE/VINF are listed above. The vertical displacement is determined on the basis of the leading- and side-edge vorticity leaving the monoplane wing surface at an angle equal to half the angle of attack seen by the wing. With a rootchord equal to 7.55, refer to figure 23, the vertical displacement at the trailing edge is given by

$$z_B = (7.55) \tan 5^\circ = 0.661 \quad (29)$$

The trailing-edge vortex characteristics are taken from the loading information output generated by program DEMON2 as a consequence of step 5

described in section 5.2.1. Trailing-edge vortex strength(s) and position(s) are taken from the results calculated on the basis of Bernoulli type loading pressures. They appear under the heading T. E. FIN VORTEX INFO.

Before the loads on the interdigitated tail section can be determined, program DEMON2 must first be run in accordance with step 8 of section 5.2.1 for the purpose of generating the data set TCPTS containing the coordinates of the control points distributed over the tail fins and the interference shell. Index NCPOUT must be set equal to 2 for this fin. The input is otherwise the same as the input to be discussed in connection with step 10. Once data set TCPTS has been generated, step 9 involves the application of program WDYBDY to the entire body length (i.e. up to the base of the tail section). The primary function of this run is to calculate the store in data set TVELS the velocity components induced by the body source panels at the control points on the tail fins and body interference shell. This last data set will be passed back to program DEMON2 in accordance with step 10.

The loads acting on the interdigitated tail-body section are calculated by program DEMON2 as per step 10 of section 5.2.1. Effects of the body nose and monoplane wing vortices will be included. The strengths and positions in the crossflow plane of these external vortices are listed in the discussion above. The input is shown in figure 33 and includes the break in sweep of the tail fins as described in section 6.2.1. For this run involving interdigitated tails, control index NDRAG must equal its default value 0. With this control, the program will not compute in plane forces used in the determination of edge suction. Note that with the Mach number at hand (1.7), the leading edge of the tail fin is supersonic for both sweep angles. Thus, the leading edge would have zero suction in this case. At the present time, program DEMON2 cannot compute in plane forces nor span loadings if the lifting surfaces under consideration involve interdigitated fins.

The input in figure 33 also includes the 6 external vortices listed in the table above. Index NVRTX=6 in namelist \$INPUT causes the program to read in the strengths and lateral coordinates of the 6 body nose and monoplane wing vortices. In figure 33, the vortex specifications start on the 9th line from the end of the input. The listed  $z_B$  (or  $z_W$ ) coordinates of the two body nose vortices are slightly in error. The number

1.8809 should have been 1.8792. The output generated by program DEMON2 using the latter value appears in figure 34. As mentioned earlier, the influences of the external vortices are accounted for in the loading calculations on the basis of their paths being aligned with the body centerline.

Pressure distributions along the meridians of the interference shell indicated in figure 23 appear under the heading AFT OF LEADING EDGE OF FIN ROOTCHORDS. The outline of the interference shell is the idealization of the actual body contour. Figure 27(a) contains calculated pressure coefficients for two meridians, at  $\theta_p = 5.64^\circ$  and  $\theta_p = 16.91^\circ$ , respectively, on the upper half of the body. Both correspond to locations on the body contour below the right upper tail fin; in fact they lie on the impact side of that fin at axial stations  $x_B = 26.11$  and  $27.91$ . The pressures in this region rise rapidly from the leading edge of the tail section to the trailing edge. On the lower half of the body, figure 27(b), pressure coefficients are shown for the  $\theta_p = 298.09^\circ$  and  $\theta_p = 354.36^\circ$  meridians through the tail section. These two meridians lie on opposite sides of the right lower fin. Consequently, the pressure on the body below the fin ( $\theta_p = 298.09^\circ$ ) is higher than the pressure above the fin ( $\theta_p = 354.36^\circ$ ).

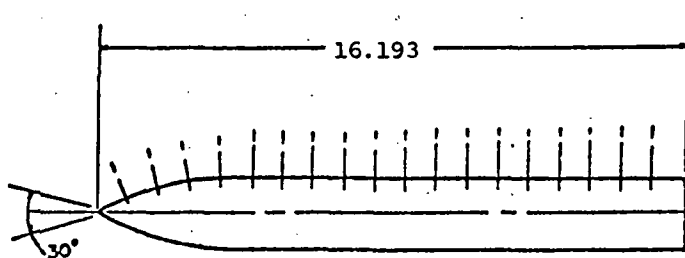
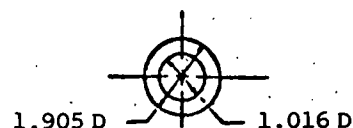
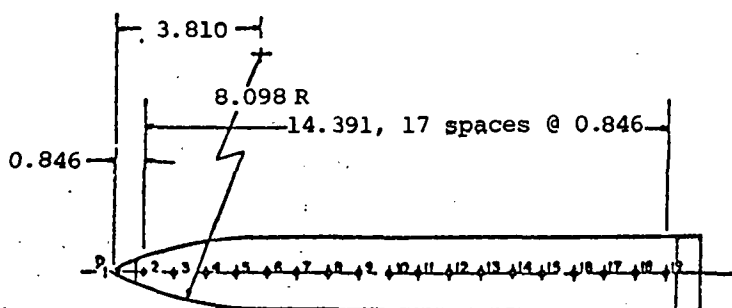
The pressure loading distributions for the upper and lower right fins appear under the heading PRESSURE LOADING AT CONTROL POINTS. Results are available on the basis of linear pressures under the heading DELTP,LIN., and on the basis of Bernoulli pressures under the heading DELTP,BERN. Forces acting on the fins in coefficient form are shown in the loading information output also for both types of loading pressures. If the effects of the body nose vortices are omitted, the loadings on the upper fins of the interdigitated tail section would be increased.

## 7. COMPARISON WITH EXPERIMENTAL DATA

During the development of the axisymmetric body modeling and pressure calculation methods described in section 3, some comparisons were made with experimental data. The ogive cylinder model shown at the top of figures 35, 36 and 37 is in fact the pressure distribution model used in connection with the store separation work associated with references 12, 13, and 14. This model is equipped with 19 pressure taps and the dimensions in inches are shown below. At the angle of attack under consideration

(5°), very little if any body vorticity will be generated. Thus, calculations were performed using program DEMON2.

The ogive cylindrical body is modeled with 30 line sources/sinks to account for volume effects and 30 line doublets to account for angle of attack. The calculated results are computed by subroutine BDYPR in conjunction with subroutine BDYGEN of program DEMON2. They are represented by a solid line in figure 35 for  $M_\infty = 1.5$ , in figure 36 for  $M_\infty = 2.0$  and in figure 37 for  $M_\infty = 2.5$ . Program DEMON2 is not capable of modeling a body alone in its present state. Thus, near the body base a set of fins are attached as far as that program is concerned. The solid line is terminated at the leading edge of this imaginary fin section.



All dimensions in cm.

In general, the calculated results match the data well for all three Mach numbers. Near the body nose, some differences are evident for the two lower Mach numbers, figures 35 and 36. It is interesting to note that if the linear pressure relationship is used instead of the Bernoulli expression, the results near the nose tip are improved. However, at other locations, the agreement is then diminished. At the highest Mach number,  $M_\infty = 2.5$ , the Mach cone at the nose tip intersects the body. The part

of the body nose outside of the Mach cone is then idealized by a conical surface, in fact by the Mach cone itself. In addition, as described in section 3, subroutine BDYGEN moves the line singularities up towards the nose in an effort to minimize the errors attendant to this approximation and the method of body modeling employed. Even so, if the pressure were calculated on the body between the nose tip and the location where the Mach cone emerges, the body singularities would have no effects. Thus, this constitutes a limit to the applicability of the body modeling method. Note that in figure 37 the most forward static pressure tap lies behind the intersection of the Mach cone and the body so that this location is affected by the forward line singularities.

## 8. CONCLUDING REMARKS

Existing cruciform wing-body computer programs have been extended and additional programs developed to compute, in a stepwise manner, pressure distributions acting on complete missile configurations. The applicable flow regime is supersonic and the configuration can be at combined angle of pitch and sideslip. The body can be circular or elliptic in cross section. The lifting surfaces can be a cruciform canard and/or cruciform tail or a monoplane wing and interdigitated tail fins. Effects of body nose- and canard- or monoplane wing-vortices, tracked along the configuration, can be accounted for in the body pressures and tail fin loadings. For cases involving axisymmetric bodies, the body nose shed vortex characteristics are built into the program. Two calculative examples are given: the first concerns a cruciform canard-axisymmetric body-cruciform tail configuration and the second involves a monoplane wing-elliptic cross section body-interdigitated tail configuration. Limited comparisons between calculated and measured pressures are shown for an ogive cylinder at  $5^\circ$  angle of attack. Fin loads comparisons are described in earlier work. Fin edge vorticity characteristics are calculated by the program from the suction distributions using Polhamus' vortex lift analogy. Some comparisons with other theories are shown for leading- and side-edge suction forces in an appendix.

Some of the limitations of the program in their range of applicability are pointed out in this report. The limitations discussed herein are consequences of the basic linear methods used to model the components



or to account for effects of vortices on the components. The limitation in applicability with regard to flow conditions is estimated to be about  $20^\circ$  in included angle of attack and supersonic velocities up to Mach number 3. A better estimate of the limitations of the program must await detailed pressure distribution data not now available.

The precision of the calculative method is associated with the number of body source panels used to model bodies with elliptical cross section, the number of discrete vortices used to represent body nose vortex shedding, and the number of constant u-velocity panels used to model the lifting surfaces.

The behavior of a vortex in the close proximity of a lifting surface can be a limiting factor in accuracy of prediction. It is possible to include a core in the model for the purpose of reducing the effect of the singularity in tangential velocity associated with the potential vortex model. To the best of our knowledge, there are no data available as yet for the vortex-shedding characteristics associated with bodies with elliptical cross section. A predictive program is available, as discussed herein, but must be thoroughly tested against experimental data not yet available.

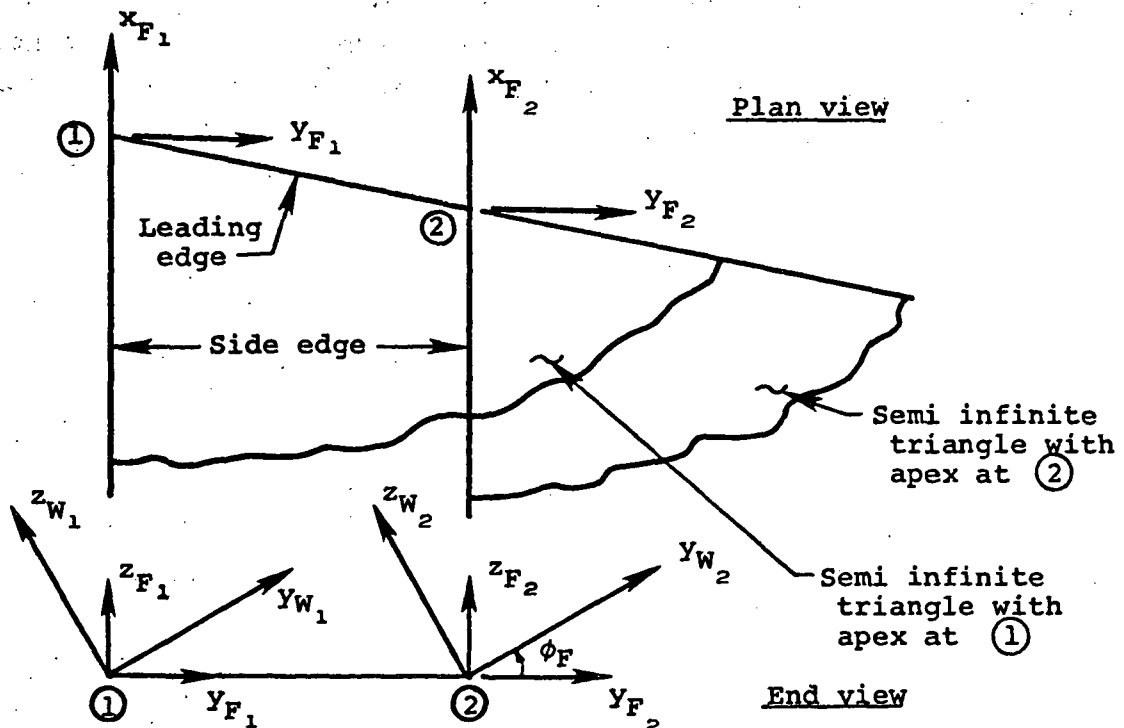
At the present time, the programs are used in a sequential manner without the benefit of an executive program. Running time is a function of the number of panels used. Some decrease in running time is possible by further refining the program.

## APPENDIX A

### SUPERPOSITION OF CORNER SOLUTIONS FOR A CONSTANT u-VELOCITY PANEL AT ARBITRARY DIHEDRAL ANGLE

In representing fin configurations by a distribution of constant u-velocity panels, questions arise concerning the coordinate system used in the panel corner superposition scheme. The superposition scheme is described in references 1 and 7. Furthermore, if the configuration geometry and flow conditions dictate symmetry in the flow field around the configuration, the aerodynamic influence coefficient matrix must reflect that condition. This appendix addresses these two topics in relation to the wing-body program DEMON2 only.

For simplicity consider only the corners on the leading edge of a constant u-velocity panel. Corners on the trailing edge are treated in the same manner. The following sketch shows the plan view and end view of the leading- and side-edges. Also indicated are the local panel coordinate systems with origins at panel corners 1 and 2. Axes  $x_{F1}$ ,  $y_{F1}$  and axes  $x_{F2}$ ,  $y_{F2}$  lie in the plane of the panel ( $z_{F1} = 0$ ,  $z_{F2} = 0$ ).



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The end view shows the local lateral coordinates  $(y_{W1}, z_{W1})$  and  $(y_{W2}, z_{W2})$  with origins at corners 1 and 2, respectively. They are parallel to the reference wing coordinate system  $(x_W, y_W, z_W)$ , and we will need velocity components in this system. Coordinate systems  $(x_{F1}, y_{F1}, z_{F1})$  and  $(x_{W1}, y_{W1}, z_{W1})$  are different by a rotation about the  $x_{F1}$  or  $x_{W1}$  axis through fin dihedral angle  $\phi_F$ . The same is true for the two systems at corner 2. The leading edge shown above has positive sweep. The superposition principle states that the solution for this infinitely long panel is given by the solution associated with the semi-infinite triangle with its apex at corner 1 minus the solution associated with the semi-infinite triangle with its apex at corner 2. Thus, in terms of flow velocity components, the superposition scheme specifies the velocity components in the  $x_F, y_F, z_F$  directions as follows for the semi-infinite panel.

$$\left. \begin{aligned} u_{F,TOT} &= u_{F1} - u_{F2} \\ v_{F,TOT} &= v_{F1} - v_{F2} \\ w_{F,TOT} &= w_{F1} - w_{F2} \end{aligned} \right\} \quad (A1)$$

The corresponding velocities in the wing coordinate system are obtained from those given by equation (A1) by means of a rotational coordinate transformation.

$$\left. \begin{aligned} v_{W,TOT} &= v_{F,TOT} \cos \phi + w_{F,TOT} \sin \phi \\ w_{W,TOT} &= w_{F,TOT} \cos \phi - v_{F,TOT} \sin \phi \end{aligned} \right\} \quad (A2)$$

In equation (A1), the superposition principle is applied to the velocities expressed in the panel coordinate system  $(x_F, y_F, z_F)$ . These velocities are then transformed to the wing coordinate system  $(x_W, y_W, z_W)$  as indicated in equation (A2).

Alternately, velocities  $v_{F1}, w_{F1}$ , and  $v_{F2}, w_{F2}$  can first be transformed into the wing coordinate system and the superposition applied to

the result. The lateral velocity components in the wing coordinate system are obtained from the ones in the panel coordinate system as follows.

$$\left. \begin{aligned} v_{W1} &= v_{F1} \cos \phi + w_{F1} \sin \phi \\ w_{W1} &= w_{F1} \cos \phi - v_{F1} \sin \phi \\ v_{W2} &= v_{F2} \cos \phi + w_{F2} \sin \phi \\ w_{W2} &= w_{F2} \cos \phi - v_{F2} \sin \phi \end{aligned} \right\} \quad (A3)$$

Applying the superposition scheme to the velocities in the wing system and substituting from equations (A3) has the result

$$\begin{aligned} v_{W,TOT} &= v_{W1} - v_{W2} = (v_{F1} - v_{F2}) \cos \phi + (w_{F1} - w_{F2}) \sin \phi \\ w_{W,TOT} &= w_{W1} - w_{W2} = (w_{F1} - w_{F2}) \cos \phi - (v_{F1} - v_{F2}) \sin \phi \end{aligned}$$

Or rewriting in terms of the quantities shown in equation (A1) then gives

$$\left. \begin{aligned} v_{W,TOT} &= v_{F,TOT} \cos \phi + w_{F,TOT} \sin \phi \\ w_{W,TOT} &= w_{F,TOT} \cos \phi - v_{F,TOT} \sin \phi \end{aligned} \right\} \quad (A4)$$

This result is the same as the expressions shown in equation (A2). The conclusion is that the superposition scheme and the coordinate rotation can be interchanged. However, in program DEMON2, the actual procedure employed is as follows: In subroutine VELNOR, the coordinates of a given field point are first calculated relative to corner 1 in the wing reference coordinate system  $(x_W, y_W, z_W)$ . These relative coordinates are then transformed to the local panel coordinate system  $(x_F, y_F, z_F)$  and the

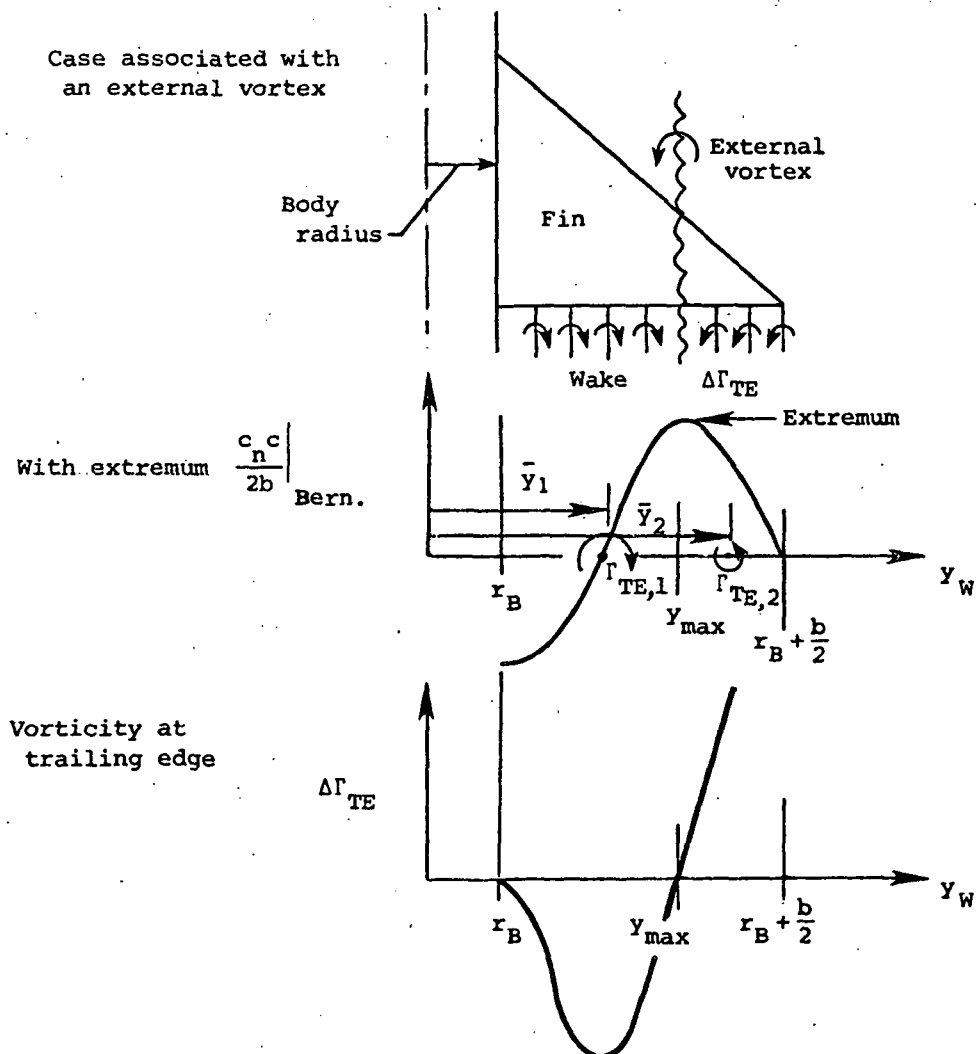
## APPENDIX A

influence of the semi-infinite triangle with apex at corner 1 is calculated at the field point by a call to subroutine VELO. The induced velocities are returned in the local coordinate system and transformed back to the wing reference system. Before proceeding to corner 2, however, subroutine VELNOR checks on the possibility of symmetry, that is, for the case of zero sideslip or symmetry in the external vortices if present. If affirmative, the effect of the image corner on the opposite side of the body must be taken into account. To accomplish this, the field point instead is moved to its image point on the other side of the fuselage. The effect of the actual corner 1 is computed there in the wing coordinate system. The velocity components calculated in this way are then transferred to the actual field point with a change in sign on the side wash,  $v$ , aligned with the  $y_w$ -axis, if corner 1 belongs to a panel on the right horizontal fin. Thus, the procedure used to account for flow symmetry depends on expressing the velocity components in the wing reference coordinate system. The same procedure applies to all corners of panels at any dihedral angle. Thus, these panels include the constant u-velocity panels on cruciform fins, interdigitated fins, monoplane wings and the interference shell.

## APPENDIX B

### DETERMINATION OF STRENGTHS AND POSITIONS OF CONCENTRATED VORTICES AT THE FIN TRAILING EDGE

Consider a fin or a wing attached to a body as shown in the following sketch. An external vortex passes over the fin. The resulting span load distribution is indicated. The distribution at the trailing edge of the trailing-edge vorticity is also shown. It is desired to determine the strength(s) and location(s) of the concentrated vortex (vortices) representing the wake.



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In order to represent the distributed trailing-edge vorticity by concentrated vortices, the spanwise load distribution based on the Bernoulli pressure expressions must be calculated first. For the case when this distribution exhibits extrema in between the end points, the number of concentrated vortices is given by the number of extrema plus 1. The trailing-edge vortex strength and position for the inboard portion of the normal-force distribution are then given by

$$\frac{\Gamma_{TE,1}}{V_\infty} = -\frac{1}{2} \int_{r_B}^{y_{\max}} \frac{\partial}{\partial y}(cc_n) dy = -\frac{1}{2} \int_{r_B}^{y_{\max}} d(cc_n) \quad (B1)$$

$$\bar{y}_1 = \frac{-\frac{1}{2} \int_{r_B}^{y_{\max}} y \frac{\partial}{\partial y}(cc_n) dy}{-\frac{1}{2} \int_{r_B}^{y_{\max}} \frac{\partial}{\partial y}(cc_n) dy} \quad (B2)$$

The basic relationship between the trailing-edge vorticity and the span-loading used here is described in detail in section 9.1 of reference 15. Fundamentally, it is shown that the rate of change in trailing-edge vorticity with spanwise distance equals the negative of the rate of change of the difference in potential between the upper and lower surfaces of the wing or fin. This is obtained by performing a contour integration parallel to the fin plane just behind the trailing edge. With simplifying assumptions, the potential difference (jump) at the trailing edge can be related to the span load distribution. The combination of these results leads to equation (B1). Integrating equation (B1) yields

$$\frac{\Gamma_{TE,1}}{V_\infty} = -\frac{1}{2} \left[ cc_n \Big|_{y_{\max}} - cc_n \Big|_{r_B} \right] \quad (B3)$$

and integration of equation (B2) by parts results in

$$\bar{y}_1 = \frac{-\frac{1}{2} \left[ y(cc_n) \int_{r_B}^{y_{\max}} - \int_{r_B}^{y_{\max}} (cc_n) dy \right]}{-\frac{1}{2} \int_{r_B}^{y_{\max}} d(cc_n)}$$

$$\bar{y}_1 = \frac{y_{\max} cc_n \Big|_{y_{\max}} - r_B cc_n \Big|_{r_B} - \int_{r_B}^{y_{\max}} (cc_n) dy}{cc_n \Big|_{y_{\max}} - cc_n \Big|_{r_B}} \quad (B4)$$

After splitting up the terms, the spanwise location of the inboard vortex is

$$\bar{y}_1 = \frac{y_{\max} cc_n \Big|_{y_{\max}} - r_B cc_n \Big|_{r_B} - \int_{r_B}^{y_{\max}} (cc_n) dy}{cc_n \Big|_{y_{\max}} - cc_n \Big|_{r_B}} - \frac{\int_{r_B}^{y_{\max}} (cc_n) dy}{cc_n \Big|_{y_{\max}} - cc_n \Big|_{r_B}} \quad (B5)$$

The strength and position of the outboard vortex is obtained in the same fashion by changing the limits of integration.

$$\frac{\Gamma_{TE,2}}{V_{\infty}} = -\frac{1}{2} \int_{y_{\max}}^{r_B + \frac{b}{2}} d(cc_n)$$

$$= -\frac{1}{2} \left[ cc_n \Big|_{r_B + \frac{b}{2}} - cc_n \Big|_{y_{\max}} \right] \quad (B6)$$



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Since the spanwise loading is zero at the side edge, equation (B6) simplifies to

$$\frac{\Gamma_{TE,2}}{V_\infty} = \frac{1}{2} cc_n \Big|_{y_{\max}} \quad (B7)$$

The spanwise location at the trailing edge is given by equation (B2) with the proper limits of integration

$$\bar{y}_2 = \frac{-\frac{1}{2} \int_{y_{\max}}^{r_B + \frac{b}{2}} y \frac{\partial}{\partial y} (cc_n) dy}{-\frac{1}{2} \int_{y_{\max}}^{r_B + \frac{b}{2}} d(cc_n)} \quad (B8)$$

After integration by parts, the result is

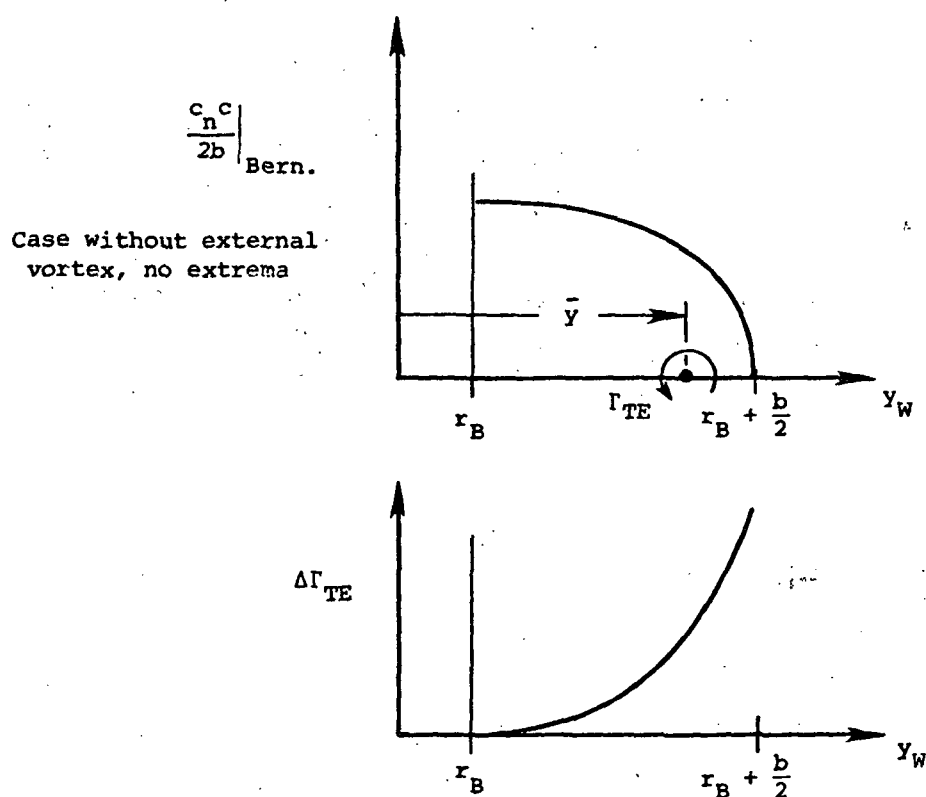
$$\begin{aligned} \bar{y}_2 &= \frac{\begin{array}{c} \nearrow \\ (r_B + \frac{b}{2}) cc_n \Big|_{r_B + \frac{b}{2}} \end{array} - y_{\max} cc_n \Big|_{y_{\max}} - \frac{\int_{y_{\max}}^{r_B + \frac{b}{2}} (cc_n) dy}{\begin{array}{c} \nearrow \\ cc_n \Big|_{r_0 + \frac{b}{2}} \end{array} - cc_n \Big|_{y_{\max}} - \frac{cc_n \Big|_{r_\Delta + \frac{b}{2}} - cc_n \Big|_{y_{\max}}}{\begin{array}{c} \nearrow \\ -y_{\max} cc_n \Big|_{y_{\max}} \end{array} - \frac{\int_{y_{\max}}^{r_B + \frac{b}{2}} (cc_n) dy}{\begin{array}{c} \nearrow \\ -cc_n \Big|_{y_{\max}} \end{array}}} \\ &= \frac{-y_{\max} cc_n \Big|_{y_{\max}}}{-cc_n \Big|_{y_{\max}}} - \frac{\int_{y_{\max}}^{r_B + \frac{b}{2}} (cc_n) dy}{-cc_n \Big|_{y_{\max}}} \end{aligned}$$

and finally

$$\bar{y}_2 = y_{\max} + \frac{\int_{y_{\max}}^{r_B + \frac{b}{2}} (cc_n) dy}{cc_n|_{y_{\max}}} \quad (B9)$$

If the span-load distribution exhibits additional extrema, equations (B3) and (B5) must be applied again with the appropriate limits of integration  $y_{\max,1}$  to  $y_{\max,2}$ . For the outboard vortex, equations (B7) and (B9) hold.

For the sake of completeness, expressions for the strength and spanwise location of the trailing-edge vorticity will be given for the case of spanwise load distributions such as the one shown below. Only one concentrated vortex is associated with this type of distribution.



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Equations (B1) and (B2) are applied again with the upper limit of integration changed to  $r_B + \frac{b}{2}$ . The results are

$$\frac{\Gamma_{TE}}{V_\infty} = -\frac{1}{2} \int_{r_B}^{r_B + \frac{b}{2}} \frac{\partial}{\partial y}(cc_n) dy \quad (B10)$$

$$\bar{y} = \frac{-\frac{1}{2} \int_{r_B}^{r_B + \frac{b}{2}} y \frac{\partial}{\partial y}(cc_n) dy}{-\frac{1}{2} \int_{r_B}^{r_B + \frac{b}{2}} \frac{\partial}{\partial y}(cc_n) dy} \quad (B11)$$

Integrating equation (B10) gives

$$\frac{\Gamma_{TE}}{V_\infty} = -\frac{1}{2} \left[ cc_n \Big|_{r_B + \frac{b}{2}} - cc_n \Big|_{r_B} \right]$$

and since the wing loading vanishes at the side edges, there results

$$\frac{\Gamma_{TE}}{V_\infty} = \frac{1}{2} cc_n \Big|_{r_B} \quad (B12)$$

After integration by parts, equation (B11) becomes

$$\bar{y} = \frac{-\frac{1}{2} \left[ y(cc_n) \Big|_{r_B}^{r_B + \frac{b}{2}} - \int_{r_B}^{r_B + \frac{b}{2}} (cc_n) dy \right]}{-\frac{1}{2} (cc_n) \Big|_{r_B}^{r_B + \frac{b}{2}}}$$

Making use again of the fact that the wing load is zero on the side edge simplifies the above equation to

$$\bar{y} = \frac{-r_B(cc_n) \Big|_{r_B} - \int_{r_B}^{r_B + \frac{b}{2}} (cc_n) dy}{-cc_n \Big|_{r_B}}$$

or

$$\bar{y} = r_B + \frac{\int_{r_B}^{r_B + \frac{b}{2}} (cc_n) dy}{cc_n \Big|_{r_B}} \quad (B13)$$

Subroutine SPNLD in program DEMON2 generates discrete values for the spanwise loading  $c_n c / 2b$  at specific  $y$  locations. The extrema are searched for. The integrals appearing in equations (B5) and (B9) can then be represented by finite summations. For example, if for a fin the number of  $y$  stations up to  $y_{\max}$  is  $MSW_{\max}$  and the total number of  $y$  stations is  $MSWR$  then the integrals are rewritten as follows.

$$\int_{r_B}^{y_{\max}} (cc_n) dy = 2b \sum_{i=1}^{MSW_{\max}} \left. \frac{c_n c}{2b} \right|_i \Delta y_i \quad (B14)$$

and

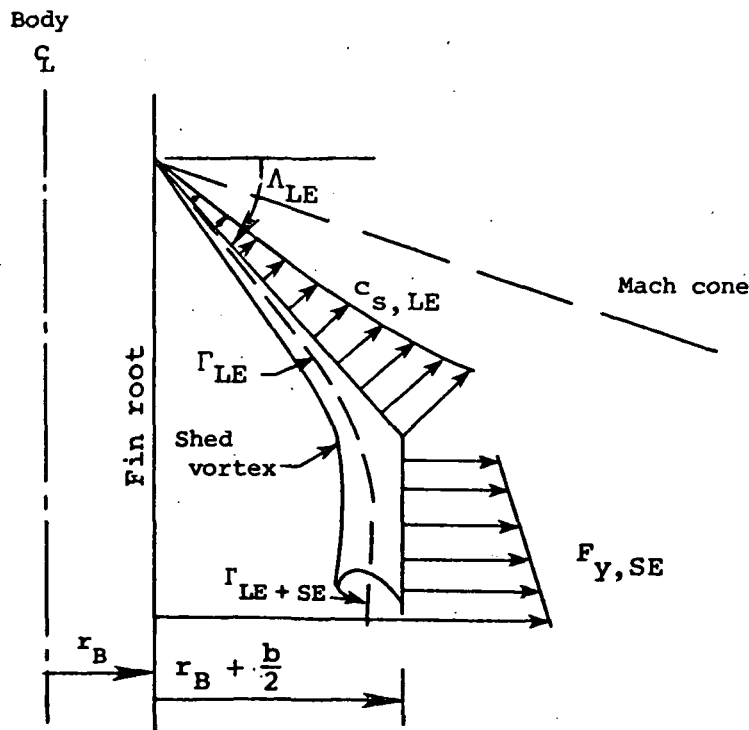
$$\int_{y_{\max}}^{r_B + \frac{b}{2}} (cc_n) dy = 2b \sum_{i=MSW_{\max}}^{MSWR} \left. \frac{c_n c}{2b} \right|_i \Delta y_i \quad (B15)$$

Subroutine SPNLD then proceeds to compute  $\Gamma_{TE}/V_{\infty}$  designated as GAMMA and  $\bar{y}$  as YCG in accordance with equations (B5) and (B9). Note again that in all of the above the span loading is based on the Bernoulli pressure calculation.

## APPENDIX C

### CALCULATION OF LEADING- AND SIDE-EDGE VORTICITY DISTRIBUTIONS

This appendix contains a description of the improved method used to calculate leading- and side-edge vorticity characteristics associated with cruciform fins on bodies in supersonic flow. First the distributions of suction force acting on these edges must be determined. Then Polhamus' leading-edge suction analogy, reference 3, is used and applied also to the side edges. As a consequence of this analogy, the normal force acting on a lifting surface in supersonic flow is augmented by an amount proportional to the suction force acting on the leading- and side-edges for sharp edges. Consider the following sketch. It shows a general planform of a fin attached to a body. A schematic distribution of the suction force along the leading- and side-edge is also indicated. The objective is to determine the position and strength of the shed vortex from knowledge of the suction distribution. Note that if the leading edge is supersonic (this occurs when the Mach cone lies between the leading edge and the fin root chord), the suction force acting on that edge equals zero.



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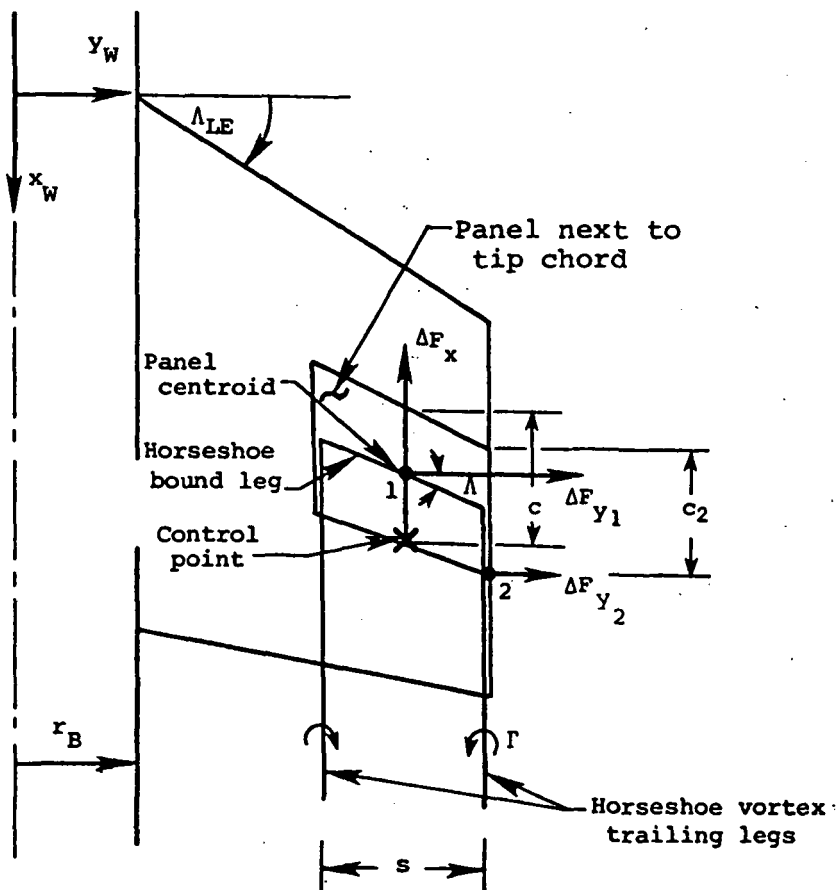
The method used to calculate the suction forces is described below in some detail. The subroutines in program DEMON2 concerned with the suction calculations are identified. The new procedure used for the side-edge suction calculation is pointed out. Calculated leading-edge thrust and suction-force distributions are compared with conical theory for the case of a slender delta wing. The predicted variation of side force along the side edge of a cropped delta wing is compared with two other theories. The side-edge suction factor, obtained using results computed by program DEMON2, is compared with conical theory for a case involving a rectangular wing.

After the suction distribution along the leading- and side-edges is described, the method used to convert the suction to edge vorticity is indicated.

### Calculation of Suction Distribution

The present method used to calculate forces acting in the plane of a fin or wing in supersonic flow was first described in reference 1. For the sake of completeness, the important features and improvements to the method will be described here in the application to the determination of the suction forces acting on the leading edge and side edge of a fin.

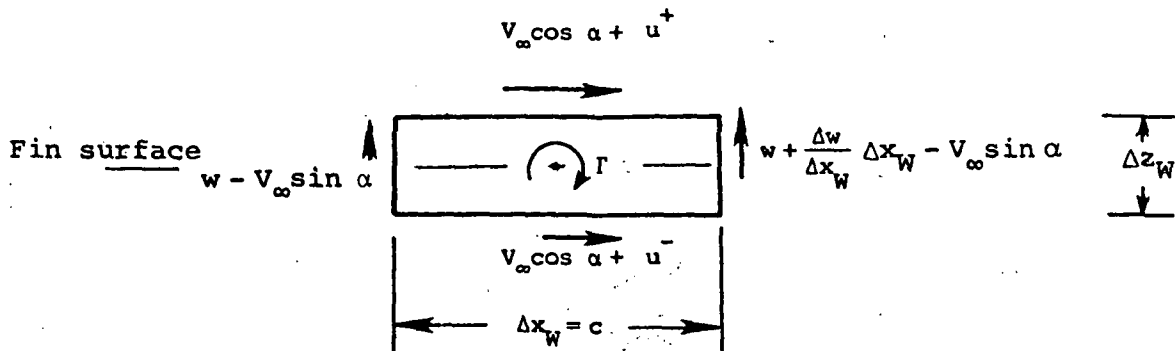
First, the constant u-velocity panel strengths are recast in vorticity strengths. In fact, an equivalent vortex lattice is constructed using the same geometric paneling layout. The bound portion of each horseshoe vortex passes through the centroid of each constant u-velocity panel while the trailing legs extend in the streamwise direction as shown in the following sketch for a horizontal fin attached to a body.



A vertical fin attached to a body is treated in a similar manner. The above sketch also shows the in-plane force  $\Delta F_x$  (acting in the negative  $x_W$ -direction) and side forces  $\Delta F_{y1}$  and  $\Delta F_{y2}$ . The quantity  $\Delta F_{y2}$  is the side force acting on the side edge for a distance  $c_2/2$  forward of point 2 and a distance  $c_2/2$  downstream of the point. It should be noted that the resultant in-plane forces must appear at the edges of the fin. The trailing edge has no such forces by virtue of the Kutta condition if subsonic, and in no event if supersonic. Thus, the elemental forces  $\Delta F_x$ ,  $\Delta F_{y1}$ , and  $\Delta F_{y2}$  summed over all the panels and vectorially added on a given fin appear either as leading- or side-edge suction forces.

The strength of the constant  $u$ -velocity panel is taken as the  $u$ -velocity in and immediately above its plane and is denoted  $u^+$ . The perturbation velocity immediately below,  $u^-$ , equals  $-u^+$ . The equivalent circulation can then be determined from the closed path (clockwise) integral of the product of the total velocity tangential to the path and the path length shown in the following sketch. Neglecting terms of higher

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order in  $\Delta x$ , the equivalent circulation strength  $\Gamma$  is then given by

$$\frac{\Gamma}{V_\infty} = 2 c \frac{u^+}{V_\infty} \quad (C1)$$

In subroutine LOADS of program DEMON2, the linear loading pressure acting on a panel is used instead of the panel strength  $u^+$  in the determination of the equivalent circulation strengths. The linear loading pressure is related to the constant u-velocity panel strength as follows.

$$\left. \frac{\Delta p}{q} \right|_{\text{linear}} = 4 \frac{u^+}{V_\infty} \quad (C2)$$

The circulation strengths are calculated using equations (C1) and (C2). The velocity normal to the panels induced by the constant u-velocity panels distributed on all fins and the body interference shell are then calculated and added to the contribution to the velocity normal to the fin induced by the singularities modeling the body. The in-plane forces can be calculated using the Kutta-Joukowski law for lift acting on a vortex filament. The forces acting on the bound vortex with sweep angle  $\Lambda$  and the side force acting on the outboard trailing leg of one panel are given by the following expressions. Angle  $\alpha$  is the sum of the angle of pitch added to the fin deflection angle if applicable.



$$\frac{\Delta F_x}{q} = 2 s \frac{\Gamma}{V_\infty} \left( \sin \alpha + \frac{w_1}{V_\infty} \right) \quad (C3)$$

$$\frac{\Delta F_{y_1}}{q} = \frac{\Delta F_x}{q} \tan \Lambda \quad (C4)$$

$$\frac{\Delta F_{y_2}}{q} = 2 c_2 \frac{\Delta \Gamma}{V_\infty} \left( \sin \alpha + \frac{w_2}{V_\infty} \right) \quad (C5)$$

In equation (C5)  $\Delta \Gamma$  is the sum of all the trailing vorticity along the panel side edge for all panels in the chordwise row ahead of the outboard aft corner. For the last panel  $c_2$  is replaced by  $c_2/2$ . The above panel forces apply to panels on a horizontal fin. For panels on the vertical fin,  $y_1$  and  $y_2$  are replaced by  $z_1$  and  $z_2$ ,  $w_1$  and  $w_2$  are replaced by  $v_1$  and  $v_2$ ,  $\sin \alpha$  is replaced by  $\sin \beta$  and the sign inside the brackets is changed to negative. Perturbation upwash velocity  $w_1$  is computed at the centroid of the panel and  $w_2$  is computed at the aft outboard corner. The forces at the centroid,  $F_x$  and  $F_{y_1}$  divided by the dynamic pressure are computed in subroutine LOADS. The side force on the outboard leg is calculated in subroutine SPNLD of program DEMON2.

The forces calculated for every panel in accordance with equations (C3) through (C5) can be summed to obtain the net in-plane forces acting on a column (strip in chordwise direction) of panels and on the entire fin. If the number of panels in a given column is large, the vector sum of forces  $\Delta F_x$  and  $(\Delta F_{y_1} + \Delta F_{y_2})$  equals the suction force for that column acting in the direction normal to the leading edge. In order to obtain good results for the leading edge without having to resort to a large number of panels it was found advantageous to calculate the suction force from the sum of the  $F_x$  forces and the leading-edge sweep of the fin under consideration. The section coefficient for suction,  $c_s$ , is the suction force per unit span divided by  $qc$ , where  $c$  is the local chord. This section coefficient is calculated in nondimensional form in

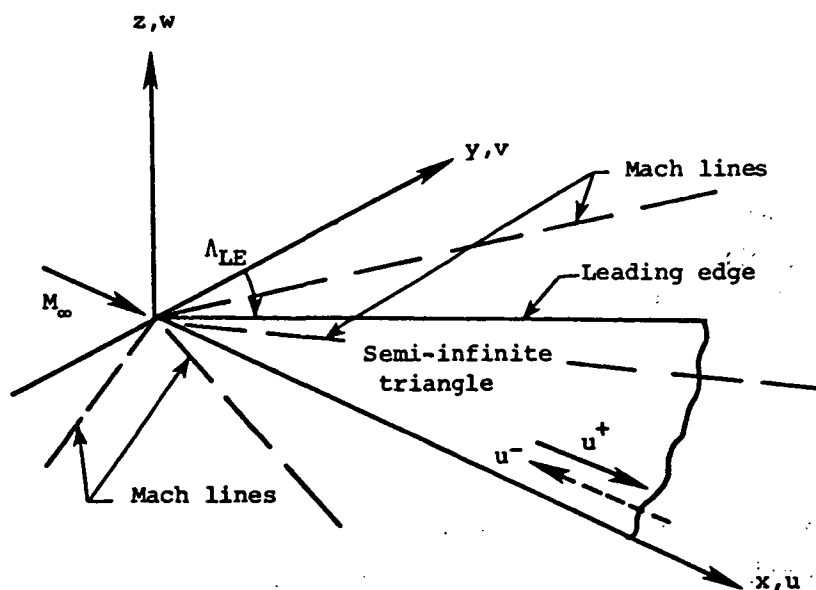
## APPENDIX C

accordance with

$$\frac{c_s c}{2b} = \frac{\sum_{i=1}^{NCW} \frac{\Delta F_x}{q} \left| \frac{i}{\lambda_{LE}} \right|}{s (2b) \cos \lambda_{LE}} \quad (C6)$$

by subroutine SPNLD of program DEMON2. The index NCW is the number of panels in the chordwise direction. Panel width  $s$  is constant for a column of panels but can vary from one column to the next. By adding the contributions from all constant  $u$ -velocity panels distributed on a fin, excluding the outboard leg side forces of the panels at the tipchord, the summed in-plane forces  $F_x$ ,  $F_{y_1}$  and  $F_{y_2}$  for the leading edge are computed in subroutine SPNLD. When divided by  $q_\infty$ , they are designated SUMFX, SUMFY1 and SUMFY2, respectively, for horizontal fins (a horizontal fin lies in the  $z_B = 0$  plane; see figure 1). Total forces  $F_x$ ,  $F_{z_1}$  and  $F_{z_2}$  are designated SUMFX, SUMFZ1 and SUMFZ2, respectively, for the vertical fins (a vertical fin lies in the  $y_B = 0$  plane). The forces acting on the outboard legs of panels at the fin tipchords are added separately and designated SUMFT2 in subroutine SPNLD. The sum represents the suction force on the side edge of the fin. Velocity components  $w_2/V_\infty$  (for horizontal fins) and  $v_2/V_\infty$  (for vertical fins) calculated at points on the side edge of fins with subsonic leading edges are calculated in accordance with the special procedure described next.

Consider a basic semi-infinite triangle with its apex at one of the corners of a constant  $u$ -velocity panel. The sketch below shows one semi-infinite triangle with two Mach lines corresponding to two free-stream Mach numbers. When the leading edge of the triangle lies inside the Mach cone, it is a subsonic leading edge. If it lies outside the Mach cone, the edge is supersonic. The outboard aft corner points of panels at the side edge, marked 2 on the second sketch of this appendix, lie on the extended leading and extended trailing edges of many panels inboard of the side edge panels. In particular, the point lies on the trailing edge of the panel shown in the sketch. If the edges are subsonic, the



contributions to the upwash from the semi-infinite triangles on whose leading edge the point lies are in fact singular as shown in figure II-1(a) in reference 7. To avoid numerical difficulties, subroutine VELO in program DEMON2 sets the downwash equal to zero. As a consequence, the points on the side edge of a fin with subsonic leading and trailing edges only receive upwash contributions from those basic semi-infinite triangles whose leading edges do not pass through the points. It was found that the side force calculated on the side edge of a cropped delta wing using the upwash,  $w_2$ , calculated this way was underestimated. By moving the points on the side edge off the fin a distance equal to the width of the nearest panel width, the values of the upwash are increased and more reasonable values for the side edge forces are obtained. For a cropped delta wing with supersonic leading and trailing edges the above problem does not exist. The upwash at the leading edge is discontinuous in this case; refer to figure II-1(c) in reference 7. The mean value is used.

A few examples will now be discussed. Consider figure C-1 first. It shows the distribution of thrust and suction along the leading edge of a delta wing with aspect ratio equal to 1. The Mach number is  $\sqrt{2}$ . The conical theory results for the linear thrust distribution shown by the lower dashed line, is based on the thrust coefficient calculated from the lift and drag coefficient for small angle of attack as follows.

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$$C_T = \alpha C_L - \left( \frac{C_{D_i}}{C_L^2} \right) C_L = \frac{T}{q c_r (b/2)} \quad (C7)$$

For a delta wing, page 292 in reference 8 contains expressions for lift and drag. The slope of the spanwise thrust distribution  $c_{t_i}/2b$  for the half wing is then related to the thrust coefficient by

$$k_T = \frac{\frac{C_T}{2} c_r}{2b} \quad (C8)$$

where  $c_r$  is the rootchord. The suction coefficient of one wing half is related to the thrust through the leading edge sweep  $\Lambda$  of the leading edge.

$$C_S \Big|_{\text{half wing}} = \frac{\frac{C_T}{2}}{\cos \Lambda} = \frac{s}{c_r (b/2) q} \quad (C9)$$

Therefore, the linear slope of the spanwise suction distribution is given by

$$k_S = \frac{C_S c_r}{2b} = \frac{k_T}{\cos \Lambda} \quad (C10)$$

The results calculated by subroutine SPNLD in program DEMON2 with a layout of five chordwise and 20 spanwise panels agree well with the linear thrust distribution from conical theory. The suction coefficient is actually calculated on the basis of vectorially adding the forward and side forces acting on all the constant u-velocity panels. The results calculated from the program are higher than the conical result from the 70 percent spanwise station on although the curve tends to return to the conical value near the tip. Nevertheless, the resultant suction force calculated this way was almost exactly normal to the leading edge. If the values of  $(c_t c)/2b$  are simply divided by  $\cos \Lambda$ , the resulting  $(c_s c)/2b$  values, as indicated by the crosses, are very close to the conical results. However, the suction as calculated in the program is away from the normal to the leading edge by a few degrees.

The distribution of the suction force along the side edge of a cropped delta wing is shown in figure C-2. Results calculated by subroutine SPNLD of program DEMON2 are indicated by the solid circles. The solid line is a distribution calculated on the basis of conical theory and given by an adapted version of equation 10 on page 8 of reference 16. Certain restrictions are imposed on the application of the expression shown in figure C-2. For example, the Mach lines from the leading edges of the tip chords must not intersect the opposite wing tip. The dashed line represents an exact linear theory result obtained by J. N. Nielsen using some of the results derived in reference 17 and the lift-cancellation method. Other than close to the leading and trailing edges of the tip chord, the program results match the exact theory well. Overall suction force along the side edge calculated by the program is slightly below that calculated by the linear theory. For this case, the leading edges and trailing edges of the panels along the side edge are subsonic near the leading edge of the side edge and supersonic near the trailing edge. This is a mixed case and the offset scheme described above may not apply to all of the points on the side edge.

The last example of suction force calculation is shown in figure C-3 for the case of a rectangular wing. The result shown by the dashed line is based on conical theory and can be obtained by the methods employed by Lamar in reference 18 for rectangular wings. The solid line is the result calculated by the program using the following definition of  $K_{V,SE}$ , the side-edge suction coefficient.

$$K_{V,SE} = \frac{2(F_{Y_2} + F_{T_2})}{qS_{Ref}\sin^2\alpha} \quad (C11)$$

Quantity  $F_{Y_2}/q$  (SUMFY2 in subroutine SPNLD) is the sum of the in-plane forces, divided by the dynamic pressure, in the  $y_w$ -direction acting at the outboard aft corner of all the panels except those next to the side edge. Quantity  $F_{T_2}/q$  (SUMFT2 in subroutine SPNLD) is the sum of the forces, divided by the dynamic pressure, in the  $y_w$ -direction acting on the outboard aft corners of the panels at the side edge. Results were calculated for five panels in the chordwise direction as a function of

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the number of panels in the spanwise direction. The solid line approaches the conical theory result as the number of spanwise panels is increased. Increasing the number of chordwise panels also improves the agreement. With 10 along the chord and 15 along the span, the point marked by the cross corresponds to  $K_{v,SE} = 1.099$ .

### Conversion of Suction to Edge Vorticity

With the distribution of suction along the leading and side edges of a given lifting surface calculated by the methods described above, the Polhamus analogy is used to convert the suction to additional normal force and accompanying edge vorticity. The analogy is described in reference 3 and states that at high angles of attack the normal force acting on a delta type wing is augmented by an amount proportional to the suction force acting on the leading edge. The additional lift is associated with flow separation along swept leading edges. This analogy is extended to the side edges of a wing or fin of general planform.

Section 6.2.3 contains a description of the procedure used to compute the increment in normal force due to edge vorticity from the suction force coefficients calculatable from quantities in the output of program DEMON2. In the following, the method for relating the distribution along the leading and side edges of suction force to the distribution of augmented normal force is indicated. Then, a discussion follows concerning the analysis required to relate the distribution of edge vorticity to the distribution of augmented normal force.

For the leading edge, the spanwise distribution of suction is given by equation (C6). Define  $K_{v,LE}$ , assumed constant, as the proportion of the suction converted to normal force

$$K_{v,LE} = \frac{\frac{\Delta c_n c}{2b}}{\frac{c_s c}{2b}} \quad (C12)$$

This factor is called the vortex lift vector for the leading edge. It is a function of leading edge sweep, Mach number and leading-edge geometry. For sharp edges, figure 9(a) in reference 4 contains graphs from which estimates can be obtained for  $K_{v,LE}$  values as a function of aspect



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The moment of the suction force divided by factor  $2b$  is formed as follows.

$$CSMOM = \sum_{i=1}^I y_{W,i} \left. \frac{c_s c}{2b} \right|_i \Delta y_{W,i} \quad (C15)$$

The spanwise location of the "center of gravity" of the suction distribution along the leading edge up to  $y_{W,I}$  is given by the ratio of the moment over the force.

$$\left. \begin{aligned} \bar{y}_W &= \frac{CSMOM}{CSINT} \\ y_{EXP} &= \bar{y}_W - r_b \end{aligned} \right\} \quad (C16)$$

A horseshoe vortex is laid-out on the wing or fin attached to the body. The outboard trailing filament is at spanwise position  $\bar{y}_W$ . The lift acting on the bound or spanwise leg is made equal to the increment in normal force due to leading-edge vorticity. Up to spanwise location  $y_{W,I}$ , the increment in normal force in coefficient form is given by equation (C13) in conjunction with equation (C14).

$$C_N \Big|_{L.E. \text{ vorticity}} = K_{V,LE} (CSINT) 2b \quad (C17)$$

Taking the component in the direction of the lift force results in

$$C_L \Big|_{L.E. \text{ vorticity}} = K_{V,LE} (CSINT) 2b \cos \alpha \quad (C18)$$

where  $\alpha$  is the angle of attack seen by the lifting surface in question. Then, with the Kutta-Joukowski law for lift on a vortex filament, the vortex strength  $\Gamma_{LE}$  associated with the added lift can be obtained from the following approximate relation.

$$\frac{\Gamma_{LE}}{V_\infty} = \frac{K_{V,LE} (CSINT) 2b \cos \alpha}{2y_{EXP}} \quad (C19)$$

This relation is correct for a wing alone ( $r_b = 0$ ) for which the span of the horseshoe vortex would be equal to  $2\bar{y}_W$  or  $2y_{EXP}$ . However, for a wing or fin attached to a body as shown in the sketch above, the span or



width of the horseshoe vortex is the difference between  $\bar{y}_W$  and the distance from the body centerline to the image (shown dashed) of the outboard trailing filament,  $r_b^2/\bar{y}_W$ . At the present time, equation (C19) is programmed in subroutine SPNLD of program DEMON2. In any event, equation (C19) provides the spanwise distribution of  $\Gamma_{LE}$  and its location  $\bar{y}_W$  is given by equation (C16).

A similar procedure is followed for determining the strength and spanwise location of vorticity along the side edge. The summing process indicated in equation (C14) to calculate quantity CSINT is continued along the side edge using the side force designated  $FT_2(J_{TIP})$  and computed in accordance with equation (C5). The vorticity associated with the added normal force is also determined by expressions (C18) and (C19) replacing  $K_{V,LE}$  with  $K_{V,SE}$ . The same remarks made above in connection with the spanwise width apply. In addition, it is recommended to set  $K_{V,SE} = K_{V,LE}$  for use in the program as written at the present time. Note that these vortex lift factors have the default value 0.5 in main routine CRFWBD of program DEMON2.

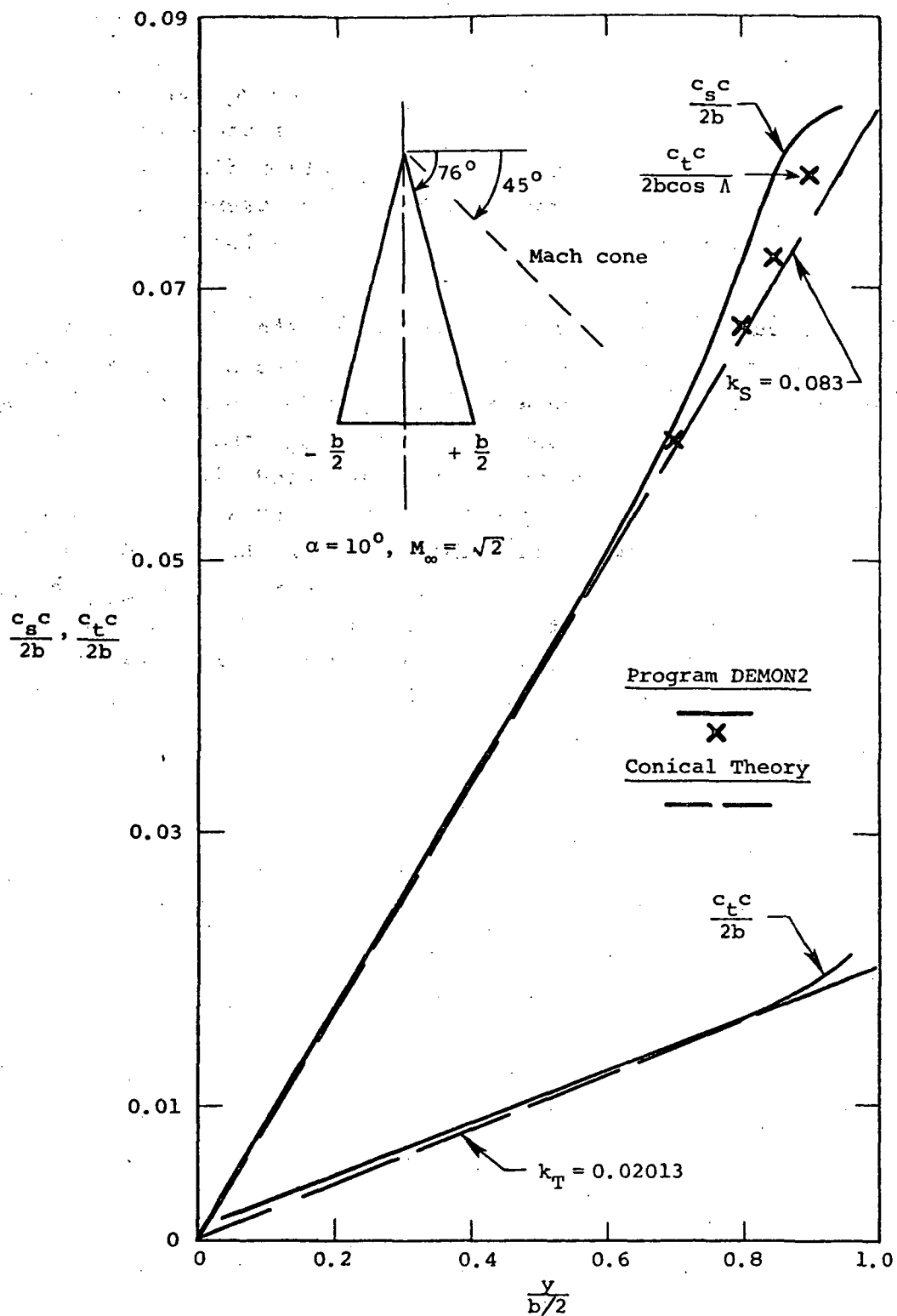


Figure C-1.- Spanload distribution of suction and thrust for a delta wing with aspect ratio 1.

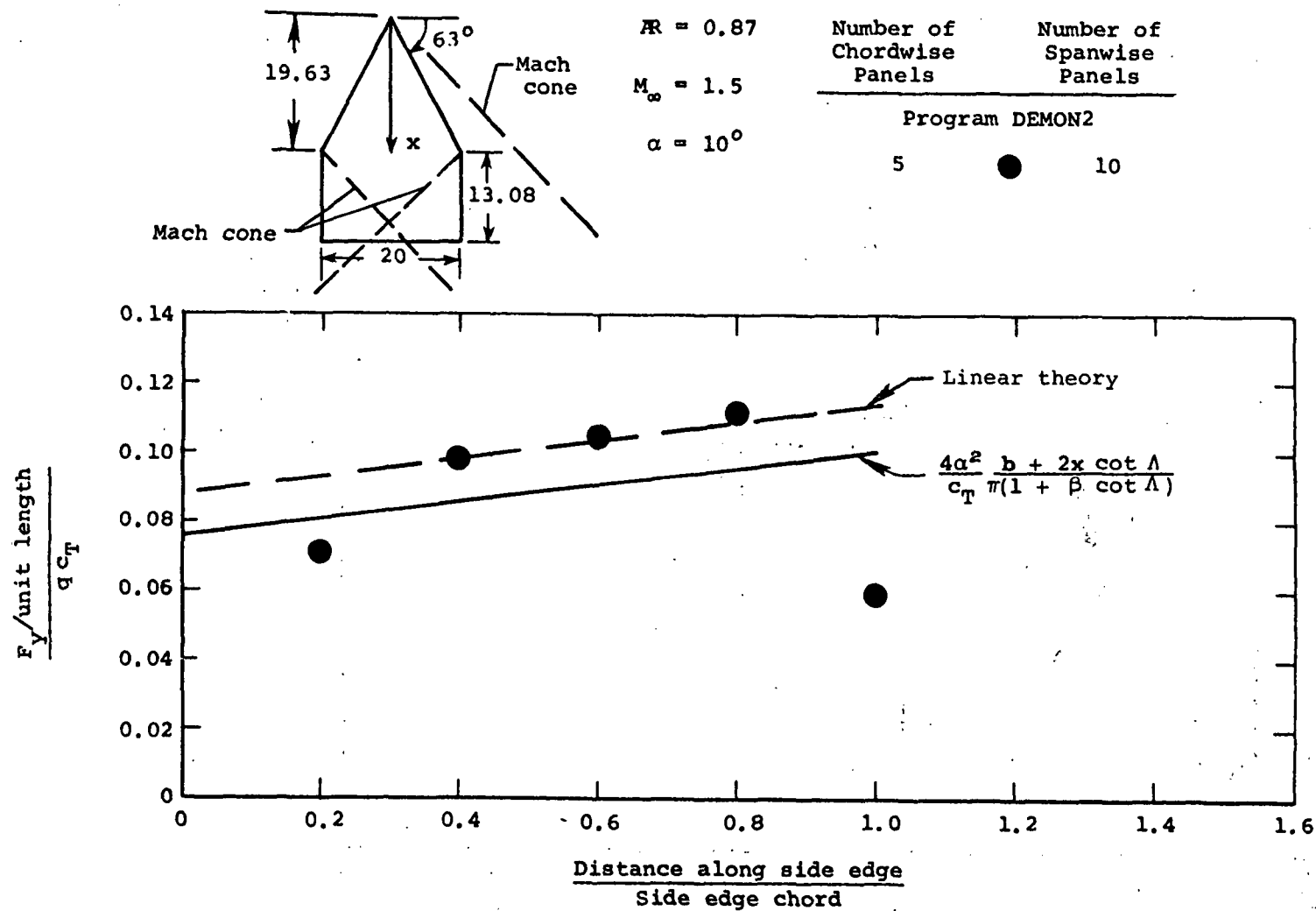


Figure C-2.- Distribution of suction force along side edge of a cropped delta wing;  $b = 20$ ,  $c_T = 13.08$ ,  $\Lambda = 63^\circ$ .

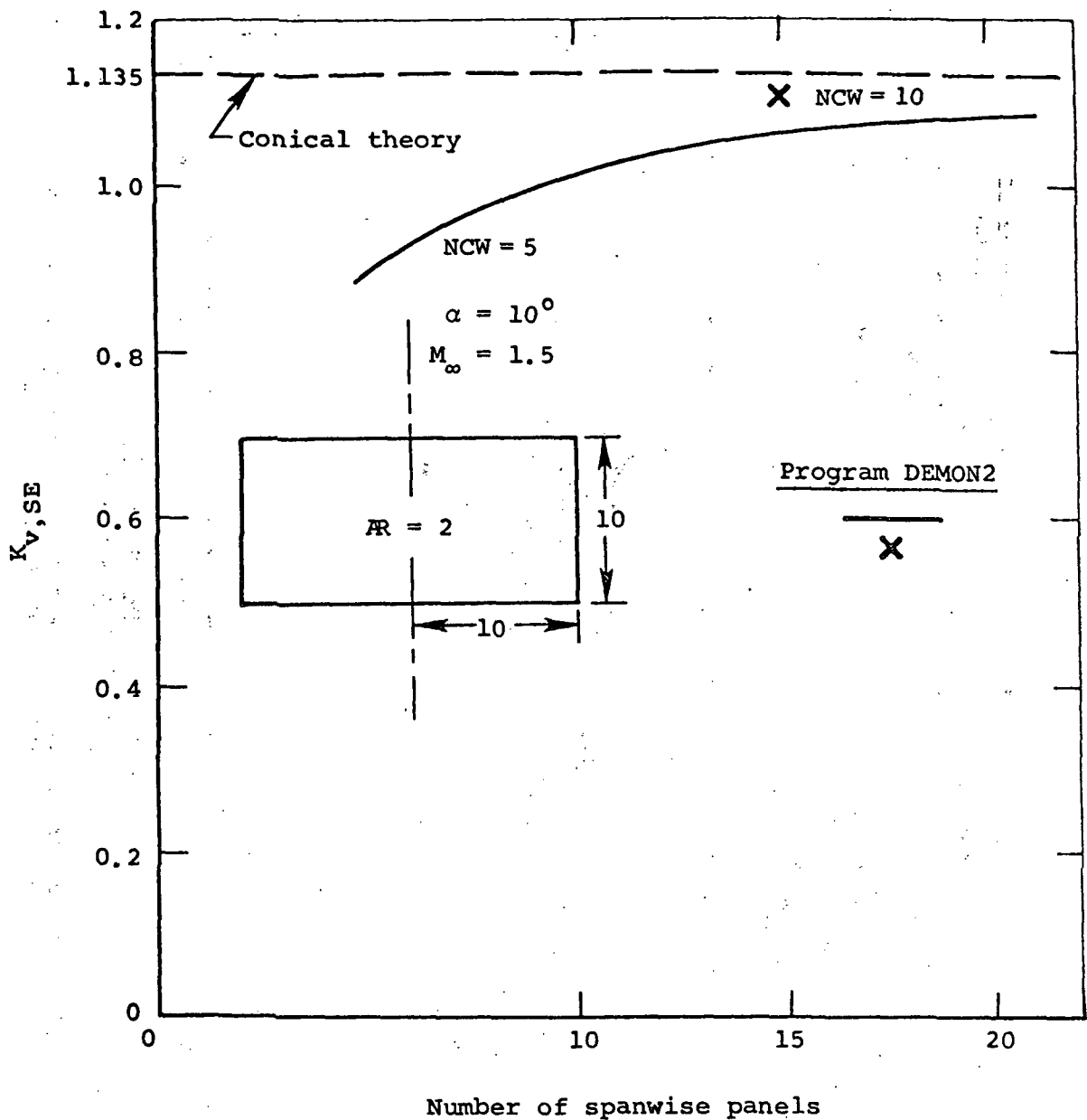
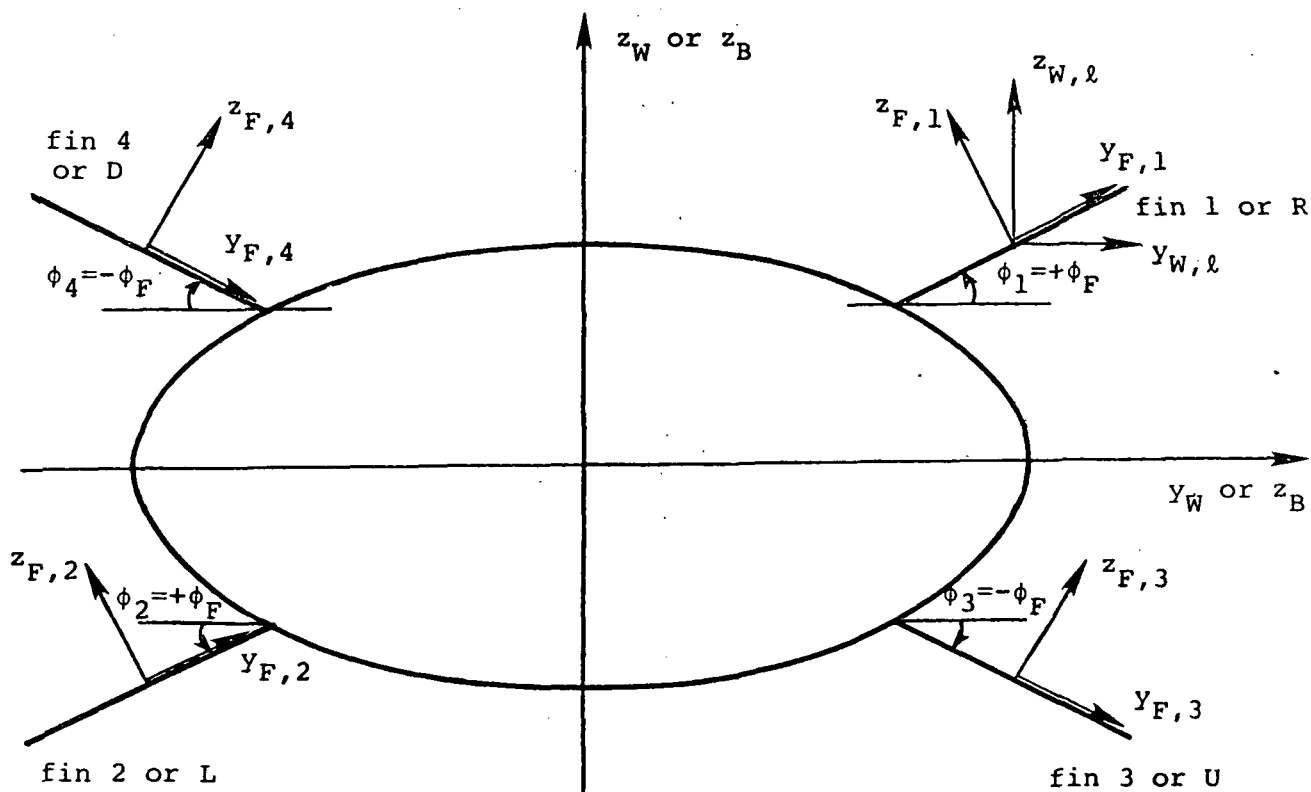


Figure C-3.- Side-edge suction factor  $K_{v,SE}$  for a rectangular wing.

## APPENDIX D

### TRANSFORMATION FROM FIN COORDINATES TO WING OR BODY REFERENCE COORDINATE SYSTEM AND VICE VERSA

In the calculation of the influence of one constant u-velocity panel at the control point of another or at a given field point, the following procedure is used. The coordinates of the four corners of all the constant u-velocity panels are calculated by subroutine LAYOUT in program DEMON2 in the wing coordinate system ( $x_W, y_W, z_W$ ). The coordinates of the control points (or field points) are also determined by subroutine LAYOUT (or specified) in the wing coordinate system. The first step is to calculate the coordinates of the point relative to the corners of the influencing panel under consideration. Then these local coordinates ( $x_{W,\ell}, y_{W,\ell}, z_{W,\ell}$ ), which are parallel to the wing coordinate system, are transformed to a panel coordinate system with the  $y_F$  and  $x_F$  axes in the plane of the fin. In this process the origin at one corner of the constant u-velocity panel remains fixed. Thus, the transformation is a simple rotation through the applicable fin dihedral angle. Only one local coordinate system is shown on each fin in the sketch below.



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For the right upper and left lower fins, fin 1 or fin R and fin 2 or fin L, the local wing to local fin coordinate transformation is stated as follows.

$$\left. \begin{aligned} y_{F,1 \text{ or } 2} &= y_{W,\ell} \cos \phi_{1 \text{ or } 2} + z_{W,\ell} \sin \phi_{1 \text{ or } 2} \\ z_{F,1 \text{ or } 2} &= z_{W,\ell} \cos \phi_{1 \text{ or } 2} - y_{W,\ell} \sin \phi_{1 \text{ or } 2} \end{aligned} \right\} \quad (D1)$$

Fin dihedral angles  $\phi_1$  and  $\phi_2$  are taken equal to the specified fin dihedral angle,  $+\phi_F$ , also shown in figure 3. The coordinate system rotation for the left upper and right lower fins, fin 4 or fin D and fin 3 or fin U is given by

$$\left. \begin{aligned} y_{F,3 \text{ or } 4} &= y_{W,\ell} \cos \phi_{3 \text{ or } 4} - z_{W,\ell} \sin \phi_{3 \text{ or } 4} \\ z_{F,3 \text{ or } 4} &= z_{W,\ell} \cos \phi_{3 \text{ or } 4} + y_{W,\ell} \sin \phi_{3 \text{ or } 4} \end{aligned} \right\} \quad (D2)$$

Fin dihedral angles  $\phi_3$  and  $\phi_4$  are taken equal to negative specified fin dihedral angle,  $-\phi_F$ . Thus, the transformation given by equations (D1) and (D2) are in fact the same provided the negative dihedral angle,  $-\phi_F$ , associated with fins 3 and 4 is substituted in equation (D1). The local fin to local wing coordinate transformation is given by the following expression. For the right upper and left lower fins, fin 1 or fin R and fin 2 or fin L, the transformation is

$$\left. \begin{aligned} y_{W,\ell} &= y_{F,1 \text{ or } 2} \cos \phi_{1 \text{ or } 2} - z_{F,1 \text{ or } 2} \sin \phi_{1 \text{ or } 2} \\ z_{W,\ell} &= z_{F,1 \text{ or } 2} \cos \phi_{1 \text{ or } 2} + y_{F,1 \text{ or } 2} \sin \phi_{1 \text{ or } 2} \end{aligned} \right\} \quad (D3)$$

Fin dihedral angles  $\phi_1$  and  $\phi_2$  are equal to positive fin dihedral angle,  $+\phi_F$ . The local fin to local wing coordinate transformation for the left upper and right lower fins, fin 4 or fin D and fin 3 or U can be expressed as

$$\left. \begin{aligned} y_{W,\ell} &= y_{F,3 \text{ or } 4} \cos \phi_{3 \text{ or } 4} + z_{F,3 \text{ or } 4} \sin \phi_{3 \text{ or } 4} \\ z_{W,\ell} &= z_{F,3 \text{ or } 4} \cos \phi_{3 \text{ or } 4} - y_{F,3 \text{ or } 4} \sin \phi_{3 \text{ or } 4} \end{aligned} \right\} \quad (D4)$$

Fin dihedral angles  $\phi_3$  and  $\phi_4$  are equal to negative specified fin dihedral angle,  $-\phi_F$ . Again, equation (D4) can be obtained from equation (D3) by accounting for the negative dihedral angle,  $-\phi_F$ , associated with fins 3 and 4.

The transformations indicated by equations (D1) and (D3) are programmed in subroutine ROTATE of program DEMON2. The former is accomplished through entry point ROTWF and the latter through entry point ROTFW in subroutine ROTATE.

The transformation given by equation (D1) also applies to the flow velocity components in the wing coordinate system  $v_W, w_W$  aligned with the  $y_W$  and  $z_W$  axes. After calculating the components  $v_W$  and  $w_W$ , the velocity components  $v_F$  and  $w_F$  in the local panel or fin coordinate system can be determined. Conversely, equation (D3) is used to transform velocities in the local panel or fin coordinate system to the local wing coordinate system which is aligned with the reference wing coordinate system ( $x_W, y_W, z_W$ ). The following appendix concerned with the flow boundary condition makes use of the above equations.

## APPENDIX E

### INTERDIGITATED FINS, BOUNDARY CONDITIONS

The flow tangency condition states that the net flow velocity normal to the fin must equal zero. Besides the free-stream component, there are external contributions from the body source panels calculated by program WDYBDY and effects induced by vortices associated with the body nose and the monoplane wing calculated by subroutine VVELS in program DEMON2. For all of these external contributions, the coordinate system in which they are expressed is the body or wing reference coordinate system. Body and wing coordinate systems are parallel to one another; see figure 1. The former has its origin at the body nose while the latter has its origin on the body centerline at the axial location of the wing or fin rootchord leading edge. Thus, in order to determine the external contribution to the flow velocity normal to the fin, the components must be resolved and added as follows.

Referring to figure 1, the sidewash,  $v_W$  or  $v_B$  is aligned with the  $y_W$  or  $y_B$  axis. Upwash  $w_W$  or  $w_B$  is in the  $z_W$  or  $z_B$  direction. The component of the flow normal to the fin surface at the  $j$ 'th control point ( $x_{CPT,j}$ ,  $y_{CPT,j}$ ,  $z_{CPT,j}$ ) can be determined from the transformations discussed in Appendix D. For example, the normal velocity components on the right upper fin, fin 1 or fin R are obtained from

$$v_{N,j} = w_{W,j} \cos \phi_1 - v_{W,j} \sin \phi_1 \quad (E1)$$

In this instance the fin dihedral angle  $\phi_1$  equals the specified fin dihedral angle  $\phi_F$  listed as PHIDIH in namelist \$INPUT of routine CRFWBD in program DEMON2. Angle  $\phi_F$  is also indicated in figure 3. The velocity normal to the left lower fin, fin 2 or fin L is also given by equation (E1) with fin dihedral angle  $\phi_2$  taken equal to dihedral angle  $\phi_F$ . For the right lower fin, fin 3 or fin U, the velocity normal to the fin surface at the  $j$ 'th control point is obtained from the velocity components expressed in the wing coordinate system as follows.

$$v_{N,j} = w_{W,j} \cos \phi_3 + v_{W,j} \sin \phi_3 \quad (E2)$$



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In this equation, angle  $\phi_3$  is taken equal to negative specified fin dihedral angle,  $-\phi_F$ . The velocity normal to the left upper fin is also given by equation (E2) substituting angle  $\phi_4$  for angle  $\phi_3$ . Angle  $\phi_4$  equals negative fin dihedral angle,  $-\phi_F$ .

Expressions (E1) and (E2) cause the normal velocity component to be aligned with the direction of the normal load  $C_N$  shown in figure 3 for each fin. The contribution from the free stream can be expressed in components directed along the wing or body coordinate system.

$$\left. \begin{aligned} W_W &= V_\infty \sin \alpha \\ V_W &= -V_\infty \sin \beta \end{aligned} \right\} \quad (E3)$$

where  $\alpha$  is angle of pitch and  $\beta$  is angle of sideslip. These angles are calculated from the combined angle of attack,  $\alpha_c$ , and the angle of roll,  $\phi$ , in accordance with the pitch-roll sequence described in the section entitled GENERAL APPROACH, equation (12).

All external contributions to the normal velocity component are added and substituted directly into equations (E1) and (E2). The sum of all the external contributions to the normal velocity at a control point on a fin must be offset by the sum of the normal velocity components induced by all constant u-velocity panels on the fins and the body interference shell. In computer program DEMON2, the contributions from the constant u-velocity panels on the fins or interference shell are determined in a coordinate system associated with the plane of the panel in question and then transformed to the wing or body coordinate system. Equations (E1) and (E2) together with the transformations discussed in Appendix D are subsequently employed to determine the normal component induced by one panel at the control point of another. The result is a set of simultaneous equations from which the unknown panel strengths can be calculated. Thickness effects from the interdigitated tail fin are not accounted for. For the case of cruciform fins, thickness effects can be accounted for and detailed expressions for the boundary condition are given in section 2 entitled GENERAL APPROACH.

## APPENDIX F

### INTERDIGITATED FINS, FORCE AND MOMENT CALCULATIONS

The following force- and moment-coefficient calculations are programmed in subroutine LOADS of program DEMON2. Each fin of an interdigitated fin configuration is dealt with separately.

#### Right upper fin:

Let  $C_{N,j}$  be equal to the normal-force coefficient for one constant u-velocity panel with control point coordinates  $x_{CPT,j}$ ,  $y_{CPT,j}$  and  $z_{CPT,j}$  specified in the wing coordinate system ( $x_W$ ,  $y_W$ ,  $z_W$ ). The positive sense of the normal force is shown in figure 3. Then the components in the positive  $z_W$  and  $y_W$  or  $z_B$  and  $y_B$  directions are given by

$$\left. \begin{aligned} C_{z,j} &= C_{N,j} \cos \phi_F \\ C_{y,j} &= -C_{N,j} \sin \phi_F \end{aligned} \right\} \quad (F1)$$

in accordance with the rotational coordinate transformation discussed in Appendix D. The pitching moment in the body coordinate system about a specified moment center ( $XM$ ,  $0$ ,  $ZM$ ) is defined as a moment with its axis normal to the  $y_B = 0$  or  $y_W = 0$  plane. Clockwise rotation about the  $y_B$  or  $y_W$  axis when viewing along its positive direction corresponds to positive pitching moment (positive pitching moment causes nose up). For one panel, the contribution to the pitching-moment coefficient is given by

$$C_{m,j} = -C_{z,j} \frac{(x_{CPT,j} - XM)}{l_{ref}} \quad (F2)$$

The yawing moment in the body coordinate system about a specified moment center ( $XM$ ,  $0$ ,  $ZM$ ) is defined as a moment with its axis normal to the  $z_B = 0$  or  $z_W = 0$  plane. Clockwise rotation about the  $z_B$  or  $z_W$  axis when viewing along its negative direction corresponds to positive yawing moment (nose to right is positive yawing). The contribution from one panel equals

# APPENDIX F

$$C_{n,j} = -C_{y,j} \frac{(x_{CPT,j} - XM)}{l_{ref}} \quad (F3)$$

Rolling moment measured about the body centerline is positive if the right fin(s) move in the clockwise direction viewing upstream. Both components  $C_{z,j}$  and  $C_{y,j}$  contribute to the rolling-moment coefficient. Thus, the contribution from one panel is

$$C_{l,j} = \frac{-C_{z,j} y_{CPT,j} + C_{y,j} z_{CPT,j}}{l_{ref}} \quad (F4)$$

By adding all contributions from the constant u-velocity panels on the right upper fin, the total force and moment coefficients acting on that fin can be determined. Thus for the upper right fin designated Fin 1 or Fin R, the forces acting on it in the  $z_W$  and  $y_W$  directions, respectively, are given in coefficient form as

$$\left. \begin{aligned} C_{z,1} \text{ or } C_{z,R} &= \sum_{j=1}^{NRP} C_{N,j} \cos \phi_F \\ C_{y,1} \text{ or } C_{y,R} &= -\sum_{j=1}^{NRP} C_{N,j} \sin \phi_F \end{aligned} \right\} \quad (F5)$$

Here NRP is the number of constant u-velocity panels on the right upper fin. The pitching-, yawing- and rolling-moment coefficients are obtained from the following expressions, respectively.

$$\left. \begin{aligned} C_{m,1} \text{ or } C_{m,R} &= \sum_{j=1}^{NRP} C_{N,j} \cos \phi_F \frac{(x_{CPT,j} - XM)}{l_{ref}} \\ C_{n,1} \text{ or } C_{n,R} &= \sum_{j=1}^{NRP} C_{N,j} \sin \phi_F \frac{(x_{CPT,j} - XM)}{l_{ref}} \\ C_{l,1} \text{ or } C_{l,R} &= -\sum_{j=1}^{NRP} \frac{(C_{N,j} \cos \phi_F y_{CPT,j} - C_{N,j} \sin \phi_F (z_{CPT,j} - ZM))}{l_{ref}} \end{aligned} \right\} \quad (F6)$$

The reference length  $\ell_{\text{ref}}$  as well as the reference area  $S_{\text{ref}}$  are specified in namelist INPUT of routine CRFWBD in program DEMON2 as REFL and SREF, respectively. Fin dihedral angle,  $\phi_1$  or  $\phi_R$ , is defined as shown in figure 3 and equals positive angle  $\phi_F$ . Angles  $\phi_F$  and  $\theta$  are specified in namelist \$INPUT in the main program CRFWBD of program DEMON2 as PHIDIH and THETIT, respectively.

### Left lower fin:

All expressions shown and discussed above for the right upper fin apply except for equation (E5) which gives the forces acting on the left lower fin. They are changed to

$$\left. \begin{aligned} C_{z,2} \text{ or } C_{z,L} &= \sum_{j=\text{NRP}+1}^{\text{NHP}} C_{N,j} \cos \phi_F \\ C_{y,2} \text{ or } C_{y,L} &= -\sum_{j=\text{NRP}+1}^{\text{NHP}} C_{N,j} \sin \phi_F \end{aligned} \right\} \quad (\text{F7})$$

where NHP is the number of constant u-velocity panels on the right upper fin plus the number of panels on the lower left fin. Likewise, the expressions (F6) for moments become

$$\left. \begin{aligned} C_{m,2} \text{ or } C_{m,L} &= -\sum_{j=\text{NRP}+1}^{\text{NHP}} C_{N,j} \cos \phi_F \frac{(x_{\text{CPT},j} - x_M)}{\ell_{\text{ref}}} \\ C_{n,2} \text{ or } C_{n,L} &= \sum_{j=\text{NRP}+1}^{\text{NHP}} C_{N,j} \sin \phi_F \frac{(x_{\text{CPT},j} - x_M)}{\ell_{\text{ref}}} \\ C_{\ell,2} \text{ or } C_{\ell,L} &= -\sum_{j=\text{NRP}+1}^{\text{NHP}} \frac{(C_{N,j} \cos \phi_F y_{\text{CPT},j} - C_{N,j} \sin \phi_F (z_{\text{CPT},j} - z_M))}{\ell_{\text{ref}}} \end{aligned} \right\} \quad (\text{F8})$$

Note that in accordance with the convention indicated in figure 3, the dihedral angle,  $\phi_2$  or  $\phi_L$ , associated with this fin equals positive angle  $\phi_F$ . Fin location angle,  $\theta_2$  or  $\theta_L$ , is defined as shown and equals positive angle  $\theta$ .

## APPENDIX F

### Right lower fin:

Referring again to figure 3, the dihedral angle of this fin,  $\phi_3$  or  $\phi_U$ , equals the negative angle,  $-\phi_F$ . The positive sense of  $C_N$  is also indicated. For this fin, the fin location angle,  $\theta_3$  or  $\theta_U$ , equals the negative angle,  $-\theta$ . All expressions shown and discussed above for the right upper fin apply except equations (F5) and (F6) for which the index of the summations is changed and also accounting for the change in sign on terms involving dihedral angle  $\phi_F$ .

$$\left. \begin{aligned} C_{Z,3} \text{ or } C_{Z,U} &= \sum_{j=NHP+1}^{N3P} C_{N,j} \cos \phi_F \\ C_{Y,3} \text{ or } C_{Y,U} &= \sum_{j=NHP+1}^{N3P} C_{N,j} \sin \phi_F \end{aligned} \right\} \quad (F9)$$

where N3P equals the number of constant u-velocity panels on the right upper fin added to the number on the left lower fin added to the number on the lower right fin. The pitching-, yawing- and rolling-moment coefficients are

$$\left. \begin{aligned} C_{m,3} \text{ or } C_{m,U} &= - \sum_{j=NHP+1}^{N3P} C_{N,j} \cos \phi_F \frac{(x_{CPT,j} - X_M)}{l_{ref}} \\ C_{n,3} \text{ or } C_{n,U} &= - \sum_{j=NHP+1}^{N3P} C_{N,j} \sin \phi_F \frac{(x_{CPT,j} - X_M)}{l_{ref}} \\ C_{l,3} \text{ or } C_{l,U} &= - \sum_{j=NHP+1}^{N3P} \frac{(C_{N,j} \cos \phi_F Y_{CPT,j} - C_{N,j} \sin \phi_F (z_{CPT,j} - Z_M))}{l_{ref}} \end{aligned} \right\} \quad (F10)$$

Left upper fin:

The dihedral angle for this fin,  $\phi_4$  or  $\phi_D$ , and its location angle,  $\theta_4$  or  $\theta_D$ , have the same sense as those for the right lower fin. Thus,  $\phi_4$  equals negative angle,  $-\phi_F$ , and  $\theta_4$  equals negative angle,  $-\theta$ . The expressions for the forces and moments acting on this fin are the same as equations (E5) and (E6) except for a change in the index and accounting for the change in sign for terms involving  $\phi_F$ .

$$\left. \begin{aligned} C_{Z,4} \text{ or } C_{Z,D} &= \sum_{j=N3P+1}^{NPANLS} C_{N,j} \cos \phi_F \\ C_{Y,4} \text{ or } C_{Y,D} &= \sum_{j=N3P+1}^{NPANLS} C_{N,j} \sin \phi_F \end{aligned} \right\} \quad (F11)$$

Here, NPANLS equals the sum of the number of constant u-velocity panels on all four fins. The pitching-, yawing- and rolling-moment coefficients are given by

$$\left. \begin{aligned} C_{m,4} \text{ or } C_{m,D} &= \sum_{j=NHP+1}^{NPANLS} C_{N,j} \cos \phi_F \frac{(x_{CPT,j} - x_M)}{l_{ref}} \\ C_{n,4} \text{ or } C_{n,D} &= \sum_{j=NHP+1}^{NPANLS} C_{N,j} \sin \phi_F \frac{(x_{CPT,j} - x_M)}{l_{ref}} \\ C_{\ell,4} \text{ or } C_{\ell,D} &= \sum_{j=NHP+1}^{NPANLS} \frac{(C_{N,j} \cos \phi_F y_{CPT,j} - C_{N,j} \sin \phi_F (z_{CPT,j} - z_M))}{l_{ref}} \end{aligned} \right\} \quad (F12)$$

If the aerodynamic loading is symmetric about the vertical or  $y_B = 0$  plane as is the case for an unrolled configuration with symmetric body nose vorticity, only the right upper and lower fins are considered and the overall sideforce,  $C_Y$ , and yawing moment,  $C_n$ , are zero.

# APPENDIX G

## BODY INTERFERENCE PANELS IN SHELL OF ELLIPTICAL CROSS SECTION, FORCE AND MOMENT CALCULATIONS

The following force and moment coefficients are computed in subroutine LOADS of program DEMON2. Let  $C_{N,k}$  be equal to the normal-force coefficient for one body interference panel (a constant u-velocity panel) with control point coordinates  $x_{CPT,k}$ ,  $y_{CPT,k}$ ,  $z_{CPT,k}$  specified in the wing coordinate system ( $x_W$ ,  $y_W$ ,  $z_W$ ). The positive sense of the normal force corresponds to a force pointing outward from the body as shown in figure 3. The components in the  $z_W$  and  $y_W$  or  $z_B$  and  $y_B$  direction are given by

$$\left. \begin{aligned} C_{z,k} &= C_{N,k} \cos \theta_{2k} \\ C_{y,k} &= C_{N,k} \sin \theta_{2k} \end{aligned} \right\} \quad (G1)$$

when  $\theta_2$  is the angle between the panel trailing edge and the  $y_W$  axis. It is calculated in accordance with

$$\left. \begin{aligned} \sin \theta_{2k} &= \frac{z_{W,k,i} - z_{W,k,i-1}}{\left[ \left( z_{W,k,i} - z_{W,k,i-1} \right)^2 + \left( y_{W,k,i} - y_{W,k,i-1} \right)^2 \right]^{\frac{1}{2}}} \\ \cos \theta_{2k} &= - \frac{y_{W,k,i} - y_{W,k,i-1}}{\left[ \left( z_{W,k,i} - z_{W,k,i-1} \right)^2 + \left( y_{W,k,i} - y_{W,k,i-1} \right)^2 \right]^{\frac{1}{2}}} \end{aligned} \right\} \quad (G2)$$

Subscript  $i$  and  $i-1$  refer to the two parallel panel side edges as shown in figure 3. Note that panel location angle  $\theta_{BIP}$  positions the side edge designated  $i$  on the body circumference (BIP stands for body interference panel).

For the  $k$ 'th body interference panel, the contribution to the pitching-moment coefficient is taken about moment center ( $x_M$ , 0,  $z_M$ ) and is given by

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$$C_{m,k} = -C_{z,k} \frac{x_{CPT,k}^{-XM}}{l_{ref}} \quad (G3)$$

where as discussed earlier in connection with the right upper fin, positive pitching corresponds to nose-up motion. The contribution to the yawing-moment coefficient from the k'th body interference panel equals

$$C_{n,k} = -C_{y,k} \frac{x_{CPT,k}^{-XM}}{l_{ref}} \quad (G4)$$

where positive yawing corresponds to nose to right motion. As is the case for the interdigitated fins, both components of the normal-force coefficient contribute to the rolling-moment coefficient.

$$C_{l,k} = \frac{-C_{z,k} y_{CPT,k} + C_{y,k} (z_{CPT,k}^{-ZM})}{l_{ref}} \quad (G5)$$

By adding all contributions from all the constant u-velocity panels laid out on the interference shell, the total force and moment coefficients acting on the part of the body covered by the interference shell can be calculated. Thus, the contributions to the overall forces acting in the  $z_W$  and  $y_W$  directions are given in coefficient form as

$$\left. \begin{aligned} C_{z,BIP} &= \sum_{k=1}^{NBIP} C_{N,k} \cos \theta_{2k} \\ C_{y,BIP} &= \sum_{k=1}^{NBIP} C_{N,k} \sin \theta_{2k} \end{aligned} \right\} \quad (G6)$$

Here, the number of constant u-velocity panels in the interference shell is given by NBIP. The contributions to the overall pitching-, yawing- and rolling-moment coefficients are specified as follows, respectively.



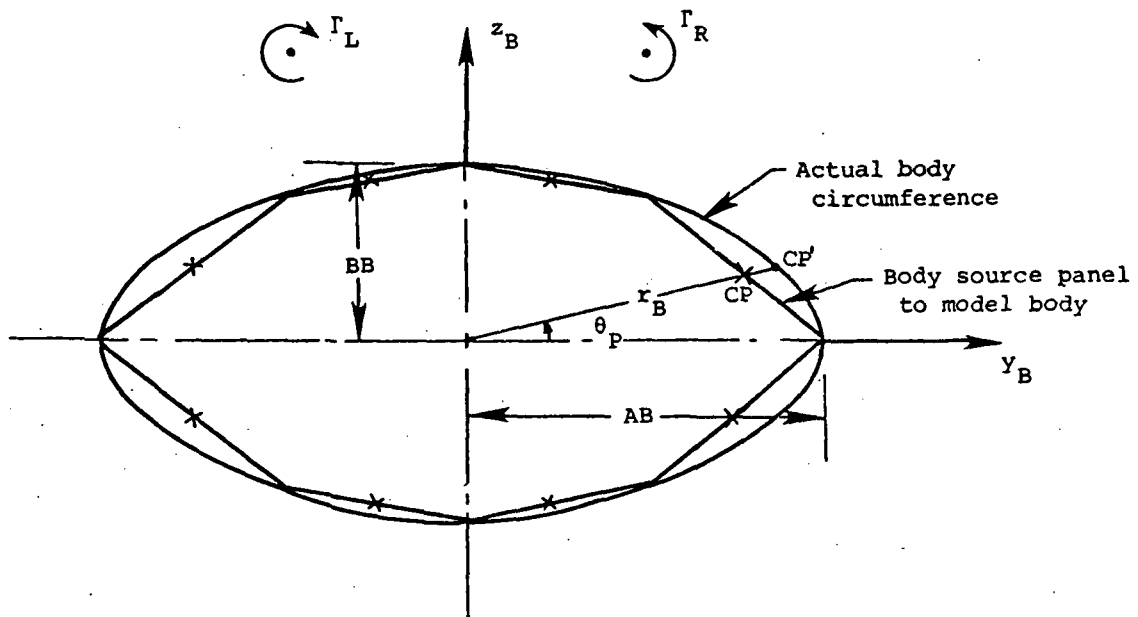
$$\left. \begin{aligned}
 C_{m,BIP} &= -\sum_{k=1}^{NBIP} C_{N,k} \cos \theta_{2k} \frac{x_{CPT,k}^{-XM}}{\ell_{ref}} \\
 C_{n,BIP} &= -\sum_{k=1}^{NBIP} C_{N,k} \sin \theta_{2k} \frac{x_{CPT,k}^{-XM}}{\ell_{ref}} \\
 C_{\ell,BIP} &= -\sum_{k=1}^{NBIP} \frac{C_{N,k} \cos \theta_{2k} y_{CPT,k} - C_{N,k} \sin \theta_{2k} (z_{CPT,k}^{-ZM})}{\ell_{ref}}
 \end{aligned} \right\} \quad (G7)$$

As mentioned earlier, the reference length  $\ell_{ref}$  and the reference area  $S_{ref}$  are specified in namelist \$INPUT of routine CRFWBD in program DEMON2 as REFL and SREF, respectively.

## APPENDIX H

### EFFECTS OF EXTERNAL VORTICITY ON BODY WITH ELLIPTICAL CROSS SECTION

The sketch below shows the circumference of an elliptical body. Also indicated are eight panels in end view as an example of a sparse body paneling layout. The panels can be source panels as employed in program WDYBDY to account for body volume, angle of pitch and angle of sideslip. However, in program DEMON2, these panels are constant u-velocity panels to account for wing-body or tail fin-body interference. In either case, the panel control points designated CP in the sketch lie inside the actual body circumference. In the calculation of pressure distribution on the body, it is desired to account for external vortices at the control points. Let  $\Gamma_R$  and  $\Gamma_L$  be body nose vorticity idealized to two potential flow vortices.



The solution for the flow field around a body with elliptical cross section in the presence of specified external vortices is given in Appendix I. This solution is programmed in subroutine VVELS in both programs WDYBDY and DEMON2 and provides valid flow field velocities at points on and outside the body circumference. However, the control points, CP, are inside the body by virtue of the method resulting in a layout of inscribed panels. For the purpose of accounting for the

## APPENDIX H

presence of the vortices, their induced velocities are calculated at points CP' instead. They lie on the intersection of the body radius which contains control point CP and the body circumference. In actuality, points CP' are displaced further out a distance equal to one percent of the body radius  $r_B$  in the programs using subroutine VVELS. This is done to prevent numerical problems encountered when computing velocities on the body surface if the coordinates of the body points are calculated and specified to subroutine VVELS. To accomplish this, the polar angle  $\theta_p$  designated THETP in the computer program is calculated first as follows.

$$\theta_p = \tan^{-1} \frac{z_{CPT}}{y_{CPT}} \quad (H1)$$

The coordinates of a given control point CP are  $x_{CPT}$ ,  $y_{CPT}$  and  $z_{CPT}$  in either the body or wing reference coordinate system. Then to determine the body radius  $r_B$  at angle  $\theta_p$ , the equation for the ellipse is used.

$$r_B^2 = \frac{1}{\frac{\cos^2 \theta_p}{AB^2} + \frac{\sin^2 \theta_p}{BB^2}} \quad (H2)$$

Here AB is the horizontal semi-axis and BB is the vertical semi-axis of the elliptical cross section for given axial body station. The coordinates of the corresponding body surface point CP' displaced one percent of the radius  $r_B$  outside the actual body circumference are

$$\begin{aligned} y_{CPB} &= 1.01r_B \cos \theta_p \\ z_{CPB} &= 1.01r_B \sin \theta_p \end{aligned} \quad (H3)$$

Thus, subroutine VVELS computes the vortex induced velocities at points CP'. These velocities are added to all other velocity component contributions calculated at the panel control points, CP. The pressure is then calculated at points CP in accordance with the Bernoulli relation, equation (10).

## APPENDIX I

### VELOCITY COMPONENTS IN CROSSFLOW PLANE REQUIRED TO CALCULATE VORTEX TRAJECTORIES

In order to calculate vortex trajectories using slender-body methods, it is necessary to know the two velocity components in the crossflow plane at the vortices. The lateral movement between two axial stations a distance  $\Delta x$  apart can be calculated from these quantities. Since a number of different cross sectional shapes in the crossflow planes are of interest in the present computer program, a number of different solutions are needed. Specifically the following eight velocity fields are used.

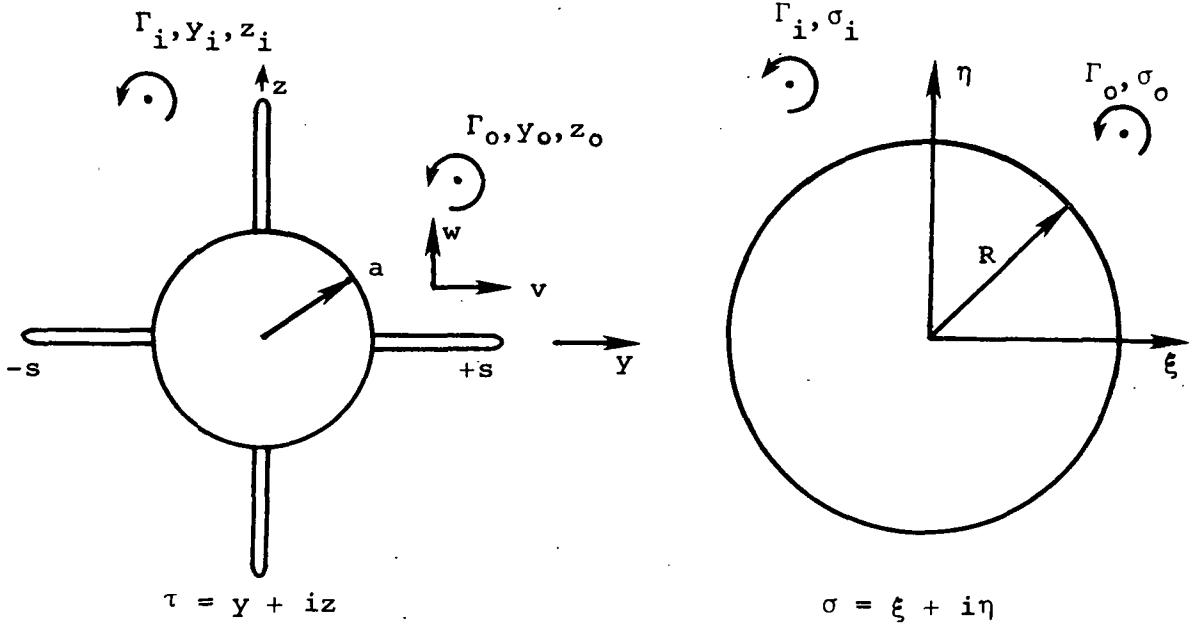
1. Velocity field induced in crossflow plane by a set of vortices in the presence of a cruciform wing-body combination on one member of the set.
2. Velocity components in crossflow plane due to pitch and bank of a cruciform wing-body combination including volume effects.
3. Flow field in crossflow plane due to symmetrical deflection of two panels of a planar wing-body combination.
4. Flow field in crossflow plane due to deflection of a single panel on a cruciform wing-body combination.
5. Velocities on a vortex due to other vortices in the crossflow plane in the presence of a monoplane midwing mounted on a body of elliptical cross-section.
6. Velocity components in crossflow plane due to pitch and bank of a monoplane midwing mounted on a body of elliptical cross-section.
7. Velocities on a vortex due to other vortices in the presence of a monoplane midwing mounted on a body of elliptical cross-section including effects of angles of pitch and sideslip.
8. Velocity components in the crossflow plane due to expansion of a body with elliptical cross sections.

The expressions for all these velocity fields are given in this Appendix. Although some of the expressions have been published elsewhere, they are all being presented here for completeness and to collect the results in one place.

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### 1.- Velocity Field Induced in Crossflow Plane by a Set of Vortices in the Presence of a Cruciform Wing-Body Combination on One Member of the Set

This solution is required to determine the trajectory of a vortex in the presence of a cruciform wing-body combination. The solution for  $v$  and  $w$  will be determined using slender-body theory. The following transformation of a cruciform wing-body into a circle of radius  $R$  is used.



$$\tau^2 + \frac{a^4}{\tau^2} = \sigma^2 + \frac{R^4}{\sigma^2} \quad 2R^2 = s^2 + \frac{a^4}{s^2} \quad (I1)$$

$$\sigma = \frac{1}{2} \left[ \sqrt{\left( \tau^2 + \frac{a^4}{\tau^2} \right)^2 - 2R^2} + \sqrt{\left( \tau^2 + \frac{R^4}{\tau^2} \right) + 2R^2} \right] \quad (I2)$$

$$\tau = \frac{1}{2} \left[ \sqrt{\left( \sigma^2 + \frac{R^4}{\sigma^2} \right)^2 - 2a^2} + \sqrt{\left( \sigma^2 + \frac{R^4}{2} \right) + 2R^2} \right] \quad (I3)$$

The potential for one vortex in the presence of the circle in the  $\sigma$  plane is

$$W_1(\sigma) = \frac{-i\Gamma_o}{2\pi} \ln(\sigma - \sigma_o) + \frac{i\Gamma_o}{2\pi} \ln \left( \sigma - \frac{R^2}{\bar{\sigma}_o} \right) \quad (I4)$$

We omit center vortices to keep the solution regular for large  $\sigma$ . The complex potential for the set of vortices is

$$W_t(\sigma) = \frac{-i\Gamma_0}{2\pi} \ln(\sigma - \sigma_0) + \frac{i\Gamma_0}{2\pi} \ln\left(\sigma - \frac{R^2}{\sigma_0}\right) - \frac{i}{2\pi} \sum_{i=1}^N \Gamma_i \ln\left[\frac{\sigma - \sigma_i}{\left(\sigma - \frac{R^2}{\sigma_i}\right)}\right] \quad (I5)$$

The complex potential in the  $\tau$  plane is given by equation (I5) with the substitution  $\sigma = \sigma(\tau)$ .

Consider now the complex potential for the motion of vortex  $\Gamma_0$  in the  $\tau$  plane.

$$W_{\Gamma_0}(\tau) = W_t(\sigma(\tau)) + \frac{i\Gamma_0}{2\pi} \ln(\tau - \tau_0) \quad (I6)$$

The velocity components of  $\Gamma_0$  in the  $\tau$  plane are

$$v_0 - iw_0 = \frac{d}{d\tau} W_{\Gamma_0}(\tau) \Big|_{\tau=\tau_0} \quad (I7)$$

$$\begin{aligned} \frac{d}{d\tau} W_{\Gamma_0}(\tau) &= \frac{d}{d\tau} \left[ \frac{-i\Gamma_0}{2\pi} \ln\left(\frac{\sigma - \sigma_0}{\tau - \tau_0}\right) \right] + \frac{d}{d\tau} \left[ \frac{i\Gamma_0}{2\pi} \ln\left(\sigma - \frac{R^2}{\sigma_0}\right) \right] \\ &\quad - \frac{i}{2\pi} \frac{d}{d\tau} \sum \Gamma_i \ln\left[\frac{\sigma - \sigma_i}{\sigma - \frac{R^2}{\sigma_i}}\right] \end{aligned} \quad (I8)$$

It is shown (ref. 4) that

$$\begin{aligned} \frac{d}{d\tau} \ln\left(\frac{\tau - \tau_0}{\sigma - \sigma_0}\right) \Big|_{\tau \rightarrow \tau_0} &= \lim_{\tau \rightarrow \tau_0} \left[ \frac{1}{\tau - \tau_0} - \frac{1}{(\sigma - \sigma_0)} \frac{d\sigma}{d\tau} \right] \\ \sigma - \sigma_0 &= (\tau - \tau_0) \left( \frac{d\sigma}{d\tau} \right)_{\tau_0} + \frac{1}{2} (\tau - \tau_0)^2 \frac{d^2\sigma}{d\tau^2} \Big|_{\tau_0} \\ \frac{d\sigma}{d\tau} &= \left( \frac{d\sigma}{d\tau} \right)_{\tau_0} + (\tau - \tau_0) \frac{d^2\sigma}{d\tau^2} \Big|_{\tau_0} \end{aligned} \quad (I9)$$

# APPENDIX I

$$\begin{aligned}
 \frac{1}{\tau - \tau_0} - \frac{1}{(\sigma - \sigma_0)} \frac{d\sigma}{d\tau} &= \frac{1}{\sigma - \sigma_0} \left( \frac{\sigma - \sigma_0}{\tau - \tau_0} - \frac{d\sigma}{d\tau} \right) \\
 &= \frac{1}{\sigma - \sigma_0} \left[ \left( \frac{d\sigma}{d\tau} \right)_{\tau_0} + \frac{1}{2} (\tau - \tau_0) \frac{d^2\sigma}{d\tau^2} \Big|_{\tau_0} \right. \\
 &\quad \left. - \frac{d\sigma}{d\tau} \Big|_{\tau_0} - (\tau - \tau_0) \frac{d^2\sigma}{d\tau^2} \Big|_{\tau_0} \dots \right] \\
 &= - \frac{1}{2} \left( \frac{\tau - \tau_0}{\sigma - \sigma_0} \right) \frac{d^2\sigma}{d\tau^2} \Big|_{\tau_0}
 \end{aligned} \tag{I10}$$

$$\lim_{\tau \rightarrow \tau_0} \left( \frac{d}{d\tau} \right) \left[ \ln \left( \frac{\tau - \tau_0}{\sigma - \sigma_0} \right) \right] = - \frac{1}{2} \left( \frac{d\tau}{d\sigma} \right)_{\tau_0} \left( \frac{d^2\sigma}{d\tau^2} \right)_{\tau_0} \tag{I11}$$

$$\begin{aligned}
 v_0 - iw_0 &= \frac{i\Gamma_0}{2\pi} \left[ - \frac{1}{2} \left( \frac{d\tau}{d\sigma} \right) \frac{d^2\sigma}{d\tau^2} \right]_{\tau_0} + \frac{i\Gamma_0}{2\pi} \frac{\bar{\sigma}_0}{\sigma_0 \bar{\sigma}_0 - R^2} \left( \frac{d\sigma}{d\tau} \right)_{\tau_0} \\
 &\quad - \frac{i}{2\pi} \sum_{i=1}^N \Gamma_i \left( \frac{1}{\sigma_0 - \sigma_i} - \frac{\bar{\sigma}_i}{\sigma_0 \bar{\sigma}_i - R^2} \right) \left( \frac{d\sigma}{d\tau} \right)_{\tau_0}
 \end{aligned} \tag{I12}$$

$$\frac{d\sigma}{d\tau} = \frac{\frac{1}{2} \left( \tau^3 - \frac{a^4}{\tau} \right) \left[ \sqrt{\left( \tau^2 + \frac{a^4}{\tau^2} \right) + 2R^2} + \sqrt{\left( \tau^2 + \frac{a^4}{\tau^2} \right) - 2R^2} \right]}{\sqrt{\left( \tau^2 + \frac{a^4}{\tau^2} \right)^2 - 4R^4}} \tag{I13}$$

Equations (I1), (I2) and (I3) yield the following relationships.

$$\frac{d\sigma}{d\tau} = \frac{(\tau^4 - a^4)\sigma^3}{\tau^3(\sigma^4 - R^4)} \tag{I14}$$

$$\frac{d^2\sigma}{d\tau^2} = \frac{\sigma^3(\tau^4 + 3a^4)}{(\sigma^4 - R^4)\tau^4} - \frac{\sigma^5(\tau^4 - a^4)^2(\sigma^4 + 3R^4)}{\tau^6(\sigma^4 - R^4)^3} \tag{I15}$$

$$\frac{d\tau}{d\sigma} \frac{d^2\sigma}{d\tau^2} = \frac{\tau^2(\sigma^4 - R^4)^2(\tau^4 + 3a^4) - \sigma^2(\tau^4 - a^4)^2(\sigma^4 + 3R^4)}{\tau^3(\sigma^4 - R^4)^2(\tau^4 - a^4)} \tag{I16}$$

With these results, we find the desired velocity

$$\begin{aligned}
 v_o - iw_o = & \frac{-i\Gamma_o}{4\pi} \frac{\left[ \tau_o^2 (\sigma_o^4 - R_o^4)^2 (\tau_o^4 + 3a^4) - \sigma_o^2 (\tau_o^4 - a^4)^2 (\sigma_o^4 + 3R_o^4) \right]}{\tau_o^3 (\sigma_o^4 - R_o^4)^2 (\tau_o^4 - a^4)} \\
 & + \frac{i\Gamma_o}{2\pi} \frac{\bar{\sigma}_o}{(\sigma_o \bar{\sigma}_o - R^2)} \frac{(\tau_o^4 - a^4) \sigma_o^3}{\tau_o^3 (\sigma_o^4 - R^4)} \\
 & - \frac{i}{2\pi} \frac{(\tau_o^4 - a^4) (\sigma_o^3)}{\tau_o^3 (\sigma_o^4 - R^4)} \sum_{i=1}^N \Gamma_i \left[ \frac{1}{\sigma_o - \sigma_i} - \frac{\bar{\sigma}_i}{\sigma_o \bar{\sigma}_i - R^2} \right] \quad (II7)
 \end{aligned}$$

where

$\Gamma_o$  = strength of vortex, the velocity components of which are being calculated

$v_o, w_o$  = velocity component of vortex  $\Gamma_o$

$\Gamma_i$  = strength of any vortex except  $\Gamma_o$ ;  $i=1,2,\dots,N$

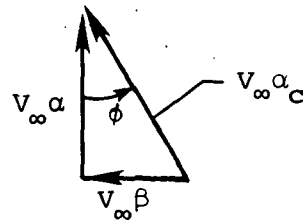
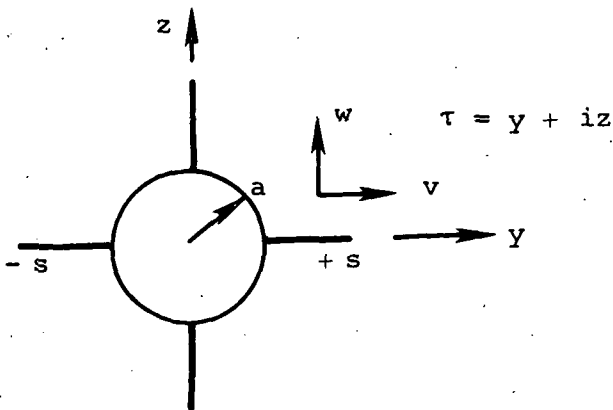
$\tau_o$  = position of  $\Gamma_o$  in  $\tau$  plane

$\sigma_o$  = position of  $\Gamma_o$  in  $\sigma$  plane

$\sigma_i$  = position of  $\Gamma_i$  in  $\sigma$  plane

## 2.- Velocity Components in Crossflow Plane Due to Pitch and Bank of a Cruciform Wing-Body Combination Including Volume Effects

For a pitched and banked cruciform missile the induced flow field can be obtained by superimposing two planar missile flow fields at right angles





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The flow field about a planar wing-body with horizontal wings is described by complex potential  $W_\alpha$  corresponding to  $V_\infty \cos \phi \sin \alpha_c$  along the positive axis of  $z$ . The complex potential  $W_\beta$  is associated with velocity  $-V_\infty \sin \phi \sin \alpha_c$  along the negative axis of  $y$ . The total potential is then

$$\frac{W(\tau)}{V_\infty} = b_0(x) + a \left( \frac{da}{dx} \right) \ln \tau + W_\alpha(\tau) + W_\beta(\tau) \quad (I18)$$

If  $\phi = 0$ , the perturbation complex potential is given in equation 5.3 of reference 8. Using the small angle approximation:

$$\frac{W(\tau)}{V_\infty} = b_0(x) + a \left( \frac{da}{dx} \right) \ln \tau - i\alpha \left\{ \left[ \left( \tau + \frac{a^2}{\tau} \right)^2 - \left( s + \frac{a^2}{s} \right)^2 \right]^{\frac{1}{2}} - \tau \right\} \quad (I19)$$

The velocity  $v-iw$  for  $\phi = 0$  is then

$$\frac{v-iw}{V_\infty} = \frac{1}{V_\infty} \frac{dW}{d\tau} = a \left( \frac{da}{dx} \right) \frac{1}{\tau} + i\alpha \frac{-i\alpha (\tau^4 - a^4)s}{\tau^2 \sqrt{(\tau^2 - s^2)(\tau^2 s^2 - a^4)}}; \phi = 0 \quad (I20)$$

and

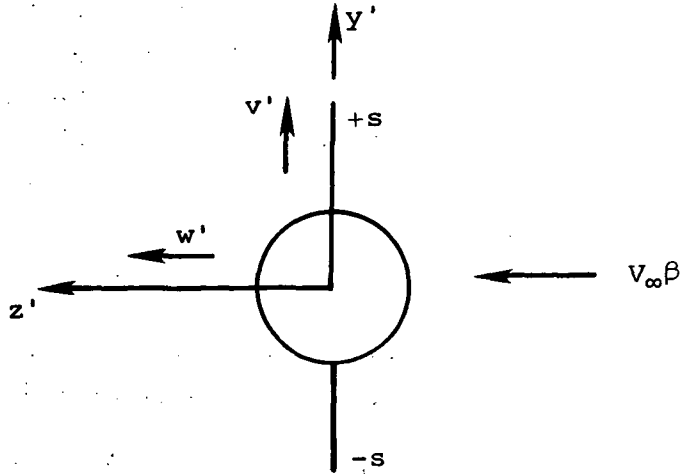
$$v-iw \rightarrow 0 \quad \text{as} \quad \tau \rightarrow \infty$$

The perturbation velocity  $v_\alpha - iw_\alpha$  associated with the velocity component  $V_\infty \alpha$  is

$$\frac{v_\alpha - iw_\alpha}{V_\infty} = \frac{-i\alpha (\tau^4 - a^4)s}{\tau^2 \sqrt{(\tau^2 - s^2)(\tau^2 s^2 - a^4)}} + i\alpha \quad (I21)$$

From this expression we can determine the perturbation velocity  $v_\beta - iw_\beta$  associated with the velocity  $V_\infty \beta$  along the negative axis of  $y$ .

Consider a set of coordinates  $y'$  and  $z'$  as shown with velocity components  $v'$  and  $w'$  with  $\tau' = -i\tau$ .



The perturbation velocity  $v' - iw'$  is given analogous to equation (I21) as

$$\begin{aligned} \frac{v' - iw'}{V_\infty} &= \frac{-i\beta (\tau'^4 - a^4)s}{\tau'^2 \sqrt{(\tau'^2 - s^2)(\tau'^2 s^2 - a^4)}} + i\beta \\ &= \frac{-i\beta (\tau^4 - a^4)s}{\tau^2 \sqrt{(\tau^2 + s^2)(\tau^2 s^2 + a^4)}} + i\beta \end{aligned} \quad (I22)$$

$$-i(v' - iw') = v_\beta - iw_\beta = \frac{-\beta (\tau^4 - a^4)s}{\tau^2 \sqrt{(\tau^2 + s^2)(\tau^2 s^2 + a^4)}} + \beta \quad (I23)$$

It is possible to add  $v_\beta - iw_\beta$  to the results of equation (I20) for  $\phi = 0$  to obtain the total complex potential for the cruciform wing-body combination since the sum satisfies the boundary condition. Accordingly we have the final result

$$\begin{aligned} v - iw &= a \left( \frac{da}{dx} \right) \left( \frac{1}{\tau} \right) + i\alpha + \beta - \frac{i\alpha (\tau^4 - a^4)s}{\tau^2 \sqrt{(\tau^2 - s^2)(\tau^2 s^2 - a^4)}} \\ &\quad - \frac{\beta (\tau^4 - a^4)s}{\tau^2 \sqrt{(\tau^2 + s^2)(\tau^2 s^2 + a^4)}} \end{aligned} \quad (I24)$$

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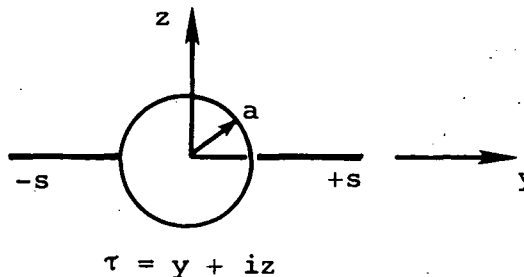
### 3.- Flow Field in Crossflow Plane Due to Symmetrical Deflection of Two Panels of a Planar Wing-Body Combination

#### 3.1 Introduction

In determining the perturbation velocity components in the flow field of a cruciform wing-body combination, we must have flow field solutions (1) for no fin deflection at  $\alpha \neq 0$ , (2) for symmetrical fin deflection of opposing panels at  $\alpha = 0$ , and (3) for the deflection of a single fin of a cruciform configuration at  $\alpha = 0$ . The first two flow fields for a cruciform wing-body can be formed by superimposing solutions for a planar wing-body combination at right angles to each other. The first solution is given in the preceding sections; the second solution is the subject of this section, and the third solution is the subject of the next section.

#### 3.2 Boundary Value Problem

Consider a planar wing-body combination with a circular body of radius  $a$  and a fin of total semispan  $s$ .



The left and right fins are deflected trailing edge down by an angular deflection  $\delta$  such that the normal velocity on the fins due to the free stream is  $V_\infty \delta$ . The complex velocity in the crossflow plane is  $v + iw$ . We have to find perturbation velocity components  $u, v, w$  at a point  $x, y, z$  in the crossflow plane. The complex variable in the crossflow plane is  $\tau = y + iz$ .

### 3.3. Method of Solution

Let  $W(\tau)$  be the complex potential for crossflow about the wing-body combination in the crossflow plane at  $x = \text{constant}$ . Let the missile cross section in the  $\tau$  plane be transformed to a circle of radius  $R_0$  in the  $\sigma$  plane. We will find a complex potential  $W(\sigma)$  which when transformed back to the  $\tau$  plane satisfies the boundary condition in this plane. If

$$\frac{dW}{d\sigma} = v - iw \quad (I25)$$

$$\frac{dW}{d\tau} = v - iw = (V - iW) \left( \frac{d\sigma}{d\tau} \right)$$

The transformation taking the missile cross section into the circle of radius  $R_0$  is

$$\tau + \frac{a^2}{\tau} = \sigma + \frac{R_0^2}{\sigma} \quad (I26)$$

with

$$2R_0 = s + \frac{a^2}{s} \quad (I27)$$

where  $a$  is the body radius and  $s$  the fin semispan. In this transformation the field far from the cross section is undistorted. The reciprocal relationships between corresponding points in the  $\sigma$  and  $\tau$  planes are obtained from the equations for the upper half plane

$$\sigma = \frac{1}{2} \left( \tau + \frac{a^2}{\tau} \right) + \frac{1}{2} \sqrt{\left( \tau + \frac{a^2}{\tau} \right)^2 - 4R_0^2} \quad (I28)$$

$$\tau = \frac{1}{2} \left( \sigma + \frac{R_0^2}{\sigma} \right) + \frac{1}{2} \sqrt{\left( \sigma + \frac{R_0^2}{\sigma} \right)^2 - 4a^2} \quad (I29)$$

On the circle  $\sigma = R_0 e^{i\theta}$ , we have

$$\tau = R_0 \cos \theta + R_0 \sqrt{\cos^2 \theta - \frac{a^2}{R_0^2}} \quad (I30)$$

If  $\theta = 0^\circ$

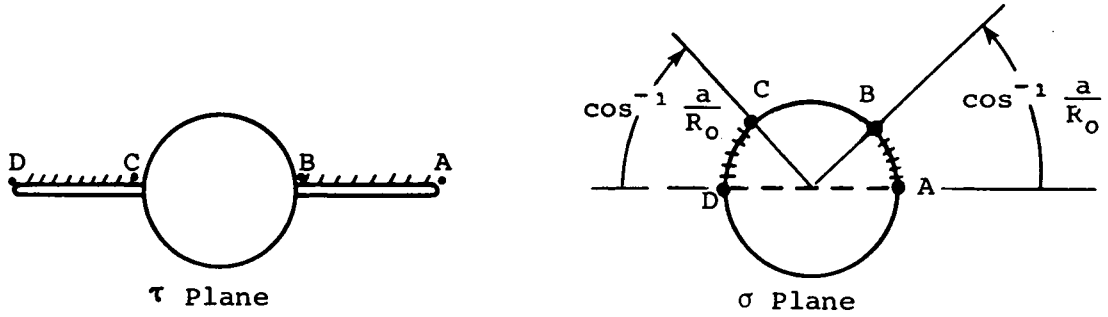
$$\tau = s \quad (I31)$$

If  $\cos \theta = a/R_0$ , then

$$\tau = a \quad (I32)$$

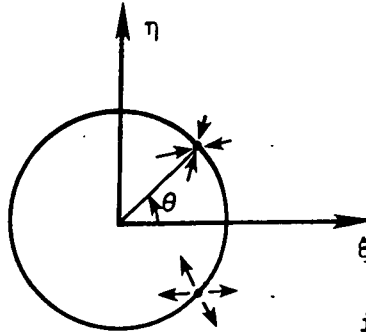
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These points are shown in the following sketch



### 3.4 Complex Potential

To obtain the complex potential, we follow a variation of the method of Adams and Dugan (ref. 21). Consider points on the upper and lower surfaces of the right wing at the same  $y$  location between  $y = a$  and  $y = s$ .



Let the corresponding points in the  $\sigma$  plane be  $R_0 e^{i\theta_0}$  and  $R_0 e^{-i\theta_0}$ .

Let a sink of strength  $dm$  exist at the point  $R_0 e^{i\theta_0}$  and a source of opposite strength exist at  $R_0 e^{-i\theta_0}$ . The complex potential due to the sum of these two singularities is

$$dw_R = -\frac{dm}{2\pi} \ln \left( \frac{\sigma - R_0 e^{i\theta_0}}{\sigma - R_0 e^{-i\theta_0}} \right) \quad (I33)$$

The circle  $R_0 e^{i\theta}$  is a streamline of the flow except at the singular points. In the  $\tau$  plane an amount of fluid  $dm/2$  enters the fin from above and an amount of fluid  $dm/2$  goes out beneath the fin. Since the upwash through the fin  $\delta V_\infty$  must be countered by the source-sink combination, we have

$$dm = 2\delta V_\infty dy \quad (I34)$$

Accordingly the complex potential due to the right fin is

$$W_R = - \frac{\delta V_\infty}{\pi} \int_a^s \ln \left( \frac{\frac{\sigma}{R_0} - e^{i\theta_0}}{\frac{\sigma}{R_0} - e^{-i\theta_0}} \right) dy \quad (I35)$$

For the left fin, we have by analogy

$$\begin{aligned} dW_L &= - \frac{dm}{\pi} \ln \left( \frac{\sigma - R_0 e^{i(\pi-\theta_0)}}{\sigma - R_0 e^{i(\pi+\theta_0)}} \right) \\ &= - \frac{dm}{2\pi} \ln \left( \frac{\sigma - R_0 e^{-i\theta_0}}{\sigma + R_0 e^{i\theta_0}} \right) \\ W_L &= - \frac{\delta V_\infty}{\pi} \int_{-s}^{-a} \ln \left( \frac{\sigma + R_0 e^{-i\theta_0}}{\sigma + R_0 e^{i\theta_0}} \right) dy \end{aligned} \quad (I36)$$

$$\begin{aligned} W_R + W_L &= - \frac{\delta V_\infty}{\pi} \int_a^s \ln \frac{\left( \frac{\sigma}{R_0} - e^{i\theta_0} \right) \left( \sigma + R_0 e^{-i\theta_0} \right)}{\left( \frac{\sigma}{R_0} - e^{-i\theta_0} \right) \left( \sigma + R_0 e^{i\theta_0} \right)} dy \\ W &= - \frac{\delta V_\infty}{\pi} \int_a^s \ln \left( \frac{\sigma^2 - R_0^2 - 2iR_0\sigma \sin \theta_0}{\sigma^2 - R_0^2 + 2iR_0\sigma \sin \theta_0} \right) dy \end{aligned} \quad (I37)$$

To solve equation (I37) for  $W(\sigma)$ , we first assume that  $\sigma$  is real, and integrate equation (I37) on this basis. We then invoke the principle of analytic continuation, and assume the result is valid for  $\sigma$  complex. The complex velocity in the  $\tau$  plane is determined by

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$$v - iw = \frac{dw}{d\sigma} \frac{d\sigma}{d\tau} \quad (I38)$$

and it can be examined to make sure it satisfies the boundary conditions. Setting

$$\frac{\sigma^2 - R_o^2}{2R_o\sigma} = \lambda \quad (I39)$$

$$W = - \frac{\delta V_\infty}{\pi} \int_a^s \ln \left( \frac{\lambda - i \sin \theta_o}{\lambda + i \sin \theta_o} \right) dy \quad (I40)$$

Integrating by parts

$$W = - \frac{\delta V_\infty}{\pi} \left[ -a \ln \left( \frac{\lambda - i \sqrt{1 - \frac{a^2}{R_o^2}}}{\lambda + i \sqrt{1 - \frac{a^2}{R_o^2}}} \right) + i \int_a^s \frac{y d(\sin \theta_o)}{\lambda - i \sin \theta_o} + i \int_a^s \frac{y d(\sin \theta_o)}{\lambda + i \sin \theta_o} \right] \quad (I41)$$

Let

$$I_1 = \int_a^s \frac{y d(\sin \theta_o)}{\lambda - i \sin \theta_o}$$

$$I_2 = \int_a^s \frac{y d(\sin \theta_o)}{\lambda + i \sin \theta_o}$$

With the help of subsequent results in section 3.6 for  $I_1 + I_2$ , we obtain

$$W(\sigma, a, R_o) = - \frac{\delta V_\infty}{\pi} \left\{ -a \ln \left( \frac{\lambda - i \sqrt{1 - \frac{a^2}{R_o^2}}}{\lambda + i \sqrt{1 + \frac{a^2}{R_o^2}}} \right) \right.$$

(equation continued on next page)

$$\left. \begin{aligned}
& - 2iR_0 \sqrt{\lambda^2 + 1} \tan^{-1} \left\{ \frac{\sqrt{\lambda^2 + 1}}{\lambda} \frac{\sqrt{1 - \frac{a^2}{R_0^2}}}{\frac{a}{R_0}} \right\} \\
& - iR_0 \pi \sqrt{\lambda^2 + 1 - \frac{a^2}{R_0^2}} + 2\lambda R_0 i \left[ \frac{\pi}{2} + \cos^{-1} \left( \frac{a}{R_0} \right) \right]
\end{aligned} \right\} \quad (I42)$$

### 3.5 Crossflow Velocity Components

Having the complex potential, we may now obtain the velocity components in the  $\sigma$  plane and the  $\tau$  plane.

$$v - iW = \frac{dW}{d\lambda} \left( \frac{d\lambda}{d\sigma} \right) \quad (I43)$$

We will carry out the differentiation

$$\ln \left( \frac{\lambda - i\sqrt{1 - \frac{a^2}{R_0^2}}}{\lambda + i\sqrt{1 - \frac{a^2}{R_0^2}}} \right) = \left[ -2i \tan^{-1} \frac{\sqrt{1 - \frac{a^2}{R_0^2}}}{\lambda} \right] \quad (I44)$$

$$\frac{d}{d\lambda} \ln \left( \frac{\lambda - i\sqrt{1 - \frac{a^2}{R_0^2}}}{\lambda + i\sqrt{1 - \frac{a^2}{R_0^2}}} \right) = \frac{+ 2i \sqrt{1 - \frac{a^2}{R_0^2}}}{\lambda^2 + 1 - \frac{a^2}{R_0^2}} \quad (I45)$$

$$\frac{d\lambda}{d\sigma} = \frac{\sigma^2 + R_0^2}{2R_0\sigma^2} \quad \lambda = \frac{\sigma^2 - R_0^2}{2R_0\sigma} \quad (I46)$$

Thus



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$$\frac{d}{d\sigma} \ln \left[ \frac{\lambda - i \sqrt{1 - \frac{a^2}{R_o^2}}}{\lambda + i \sqrt{1 - \frac{a^2}{R_o^2}}} \right] = \frac{4iR_o \left( \sigma^2 + R_o^2 \right) \sqrt{1 - \frac{a^2}{R_o^2}}}{\left( \sigma^2 + R_o^2 \right)^2 - 4a^2 \sigma^2} \quad (I47)$$

The other differentiation yields

$$\begin{aligned} \frac{d}{d\sigma} \left[ \sqrt{\lambda^2 + 1} \tan^{-1} \left[ \frac{\sqrt{\lambda^2 + 1}}{\lambda} \frac{\sqrt{1 - \frac{a^2}{R_o^2}}}{\frac{a}{R_o}} \right] \right] &= \frac{2(\sigma^2 + R_o^2) a \sqrt{1 - \frac{a^2}{R_o^2}}}{(\sigma^2 + R_o^2)^2 - 4a^2 \sigma^2} \\ &+ \frac{(\sigma^2 - R_o^2)}{2R_o \sigma^2} \tan^{-1} \left[ \left( \frac{\sigma^2 + R_o^2}{\sigma^2 - R_o^2} \right) \left( \frac{\sqrt{1 - \frac{a^2}{R_o^2}}}{\frac{a}{R_o}} \right) \right] \end{aligned} \quad (I48)$$

$$\frac{d}{d\sigma} \sqrt{\lambda^2 + 1 - \frac{a^2}{R_o^2}} = \frac{\sigma^4 - R_o^4}{2R_o \sigma^2} \frac{1}{\sqrt{(\sigma^2 + R_o^2)^2 - 4a^2 \sigma^2}}$$

The expression in complex form for  $V - iW$  is

$$\begin{aligned} V - iW = -\frac{\delta V_\infty}{\pi} &\left\{ -\frac{4iaR_o(\sigma^2 + R_o^2) \sqrt{1 - \frac{a^2}{R_o^2}}}{(\sigma^2 + R_o^2)^2 - 4a^2 \sigma^2} - \frac{4iaR_o(\sigma^2 + R_o^2) \sqrt{1 - \frac{a^2}{R_o^2}}}{(\sigma^2 + R_o^2)^2 - 4a^2 \sigma^2} \right. \\ &\left. - \frac{i(\sigma^2 - R_o^2)}{\sigma^2} \tan^{-1} \left[ \left( \frac{\sigma^2 + R_o^2}{\sigma^2 - R_o^2} \right) \left( \frac{\sqrt{1 - \frac{a^2}{R_o^2}}}{\frac{a}{R_o}} \right) \right] \right\} \end{aligned}$$

(equation continued on next page)

$$\left. -\frac{i\pi}{2\sigma^2} \frac{(\sigma^4 - R_O^4)}{\sqrt{(\sigma^2 + R_O^2)^2 - 4a^2\sigma^2}} + \frac{i(\sigma^2 + R_O^2)}{\sigma^2} \left[ \frac{\pi}{2} + \cos^{-1} \left( \frac{a}{R_O} \right) \right] \right\} \quad (I49)$$

We now determine  $v - iw$  in the  $\tau$  plane

$$v - iw = (V - iW) \frac{d\sigma}{d\tau} \quad (I50)$$

From the transformation we find the following relationships

$$\left. \begin{aligned} \frac{d\sigma}{d\tau} &= \frac{\sigma^2}{(\sigma^2 - R_O^2)} \frac{(\tau^2 - a^2)}{\tau^2} \\ \frac{\sigma^2 + R_O^2}{\sigma} &= \tau + \frac{a^2}{\tau} \\ \frac{\sigma^2 - R_O^2}{\sigma} &= \sqrt{\left( \tau + \frac{a^2}{\tau} \right)^2 - 4R_O^2} \end{aligned} \right\} \quad (I51)$$

The following results are needed to accomplish the transformation of the results to the  $\tau$  plane

$$\begin{aligned} \frac{\sigma^2 + R_O^2}{(\sigma^2 + R_O^2)^2 - 4a^2\sigma^2} \left( \frac{d\sigma}{d\tau} \right) &= \frac{\frac{\sigma^2 + R_O^2}{\sigma}}{\left[ \frac{\sigma^2 + R_O^2}{\sigma} \right]^2 - 4a^2} \frac{\sigma}{(\sigma^2 - R_O^2)} \left( \frac{\tau^2 - a^2}{\tau^2} \right) \\ &= \frac{\left( \tau + \frac{a^2}{\tau} \right)}{\left[ \left( \tau + \frac{a^2}{\tau} \right)^2 - 4a^2 \right]} \frac{1}{\sqrt{\left( \tau + \frac{a^2}{\tau} \right)^2 - 4R_O^2}} \left( \frac{\tau^2 - a^2}{\tau^2} \right) \\ &= \frac{(\tau^2 + a^2)}{(\tau^2 - a^2) \sqrt{(\tau^2 + a^2)^2 - 4R_O^2\tau^2}} \end{aligned} \quad (I52)$$

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Since

$$\frac{\sigma^2 - R_o^2}{\sigma^2} \frac{d\sigma}{d\tau} = \left( \frac{\tau^2 - a^2}{\tau^2} \right) \quad (I53)$$

we find

$$\left( \frac{d\sigma}{d\tau} \right) \left( \frac{\sigma^2 - R_o^2}{\sigma^2} \right) \tan^{-1} \left[ \left( \frac{\sigma^2 + R_o^2}{\sigma^2 - R_o^2} \right) \frac{\sqrt{1 - \frac{a^2}{R_o^2}}}{\frac{a}{R_o}} \right] = \left( \frac{\tau^2 - a^2}{\tau^2} \right) \tan^{-1} \left[ \frac{(\tau^2 + a^2) \sqrt{1 - \frac{a^2}{R_o^2}}}{\left( \frac{a}{R_o} \right) \sqrt{(\tau^2 + a^2)^2 - 4R_o^2 \tau^2}} \right] \quad (I54)$$

$$\frac{\sigma^4 - R_o^4}{\sigma^2 \sqrt{(\sigma^2 + R_o^2)^2 - 4a^2 \sigma^2}} \left( \frac{d\sigma}{d\tau} \right) = \frac{(\tau^2 + a^2)}{\tau^2} \quad (I55)$$

$$\frac{\sigma^2 + R_o^2}{\sigma^2} \frac{d\sigma}{d\tau} = \frac{\tau^4 - a^4}{\tau^2 \sqrt{(\tau^2 + a^2)^2 - 4R_o^2 \tau^2}} \quad (I56)$$

These results yield the complex velocity in the  $\tau$  plane.

$$(v - iw) = \frac{\delta V_\infty}{\pi} \left\{ i \left( \frac{\tau^2 - a^2}{\tau^2} \right) \tan^{-1} \left[ \frac{(\tau^2 + a^2) \sqrt{1 - \frac{a^2}{R_o^2}}}{\left( \frac{a}{R_o} \right) \sqrt{(\tau^2 + a^2)^2 - 4R_o^2 \tau^2}} \right] \right\}$$

(equation continued on next page)

$$\left. \begin{aligned} &+ i \left( \frac{\pi}{2} \right) \frac{\tau^2 + a^2}{\tau^2} - \frac{i}{\sqrt{(\tau^2 + a^2)^2 - 4R_0^2 \tau^2}} \left( \frac{\tau^4 - a^4}{\tau^2} \right) \\ &\left[ \frac{\pi}{2} + \cos^{-1} \left( \frac{a}{R_0} \right) \right] \end{aligned} \right\} \quad (I57)$$

The expression can be broken down into real and imaginary parts to obtain v and w, but is probably more convenient to obtain v - iw on the computer using complex calculations.

### 3.6 Evaluation of Certain Definite Integrals

The following integrals are to be evaluated

$$I_1 = \int_0^{\pi/2} \frac{y d(\sin \theta)}{\sqrt{1 - a^2/R_0^2} \lambda - i \sin \theta} \quad (I58)$$

$$I_2 = \int_0^{\pi/2} \frac{y d(\sin \theta)}{\sqrt{1 - a^2/R_0^2} \lambda + i \sin \theta} \quad (I59)$$

where

$$y = R_0 \left[ \cos \theta + \sqrt{1 - \frac{a^2}{R_0^2} - \sin^2 \theta} \right] \quad (I60)$$

We want the sum  $I_1 + I_2$  in particular

$$I_1 + I_2 = 2\lambda R_0 \int_0^{\pi/2} \frac{1}{\sqrt{1 - a^2/R_0^2} \lambda^2 + \sin^2 \theta} \left( \cos \theta + \sqrt{1 - \frac{a^2}{R_0^2} - \sin^2 \theta} \right) d(\sin \theta) \quad (I61)$$

$$= 2\lambda R_0 \left[ (1 + \lambda^2) \int_{\cos^{-1} a/R_0}^{\pi/2} \frac{d\theta}{(\lambda^2 + \sin^2 \theta)} - \int_{\cos^{-1} a/R_0}^{\pi/2} d\theta \right]$$

(equation continued on next page)

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$$\begin{aligned}
 & + \left(1 - \frac{a^2}{R_0^2} + \lambda^2\right) \int_0^{\cos^{-1}(a/R_0)} \frac{d(\sin \theta)}{\sqrt{1 - a^2/R_0^2} (\lambda^2 + \sin^2 \theta) \sqrt{1 - \frac{a^2}{R_0^2} - \sin^2 \theta}} \\
 & - \int_0^{\cos^{-1}(a/R_0)} \frac{d(\sin \theta)}{\sqrt{1 - a^2/R_0^2} \sqrt{1 - \frac{a^2}{R_0^2} - \sin^2 \theta}} \Bigg] \quad (I62)
 \end{aligned}$$

(Concluded)

We now integrate each of the four separate integrals. From pg. 323 in reference 19.

$$\begin{aligned}
 \int_{\cos^{-1}(a/R_0)}^0 \frac{d\theta}{(\lambda^2 + \sin^2 \theta)} &= \frac{1}{\sqrt{\lambda^2(\lambda^2 + 1)}} \tan^{-1} \left[ \frac{\sqrt{\lambda^2(\lambda^2 + 1)} \tan \theta}{\lambda^2} \right] \Bigg|_{\cos^{-1}(a/R_0)}^0 \\
 &= - \frac{1}{\lambda \sqrt{\lambda^2 + 1}} \tan^{-1} \left[ \frac{\sqrt{\lambda^2 + 1}}{\lambda} \frac{\sqrt{1 - \frac{a^2}{R_0^2}}}{\left(\frac{a}{R_0}\right)} \right] \quad (I63)
 \end{aligned}$$

$$\int_{\cos^{-1}(a/R_0)}^0 d\theta = - \cos^{-1} \left( \frac{a}{R_0} \right) \quad (I64)$$

The third integral can be evaluated with the help of the following result from page 55 in reference 20.

$$\int \frac{dx}{(\lambda^2 + x^2) \sqrt{v^2 - x^2}} = \frac{1}{\lambda \sqrt{\lambda^2 + v^2}} \tan^{-1} \frac{x \sqrt{\lambda^2 + v^2}}{\lambda \sqrt{v^2 - x^2}} + C \quad (I65)$$

$$\int_0^{\cos^{-1}(a/R_0)} \frac{d(\sin \theta)}{\sqrt{1 - a^2/R_0^2} (\lambda^2 + \sin^2 \theta) \sqrt{1 - \frac{a^2}{R_0^2} - \sin^2 \theta}} = \frac{1}{\lambda \sqrt{\lambda^2 + 1 - \frac{a^2}{R_0^2}}}$$

$$\tan^{-1} \left[ \frac{\sqrt{\lambda^2 + 1 - \frac{a^2}{R_o^2}} \sin \theta}{\lambda \sqrt{1 - \frac{a^2}{R_o^2} - \sin^2 \theta}} \right] \Big|_0^{\sqrt{1 - a^2/R_o^2}} = - \left( \frac{\pi}{2} \right) \frac{1}{\lambda \sqrt{\lambda^2 + 1 - \frac{a^2}{R_o^2}}} \quad (I66)$$

The fourth integral is

$$\int_0^{\sqrt{1 - a^2/R_o^2}} \frac{d(\sin \theta)}{\sqrt{1 - \frac{a^2}{R_o^2} - \sin^2 \theta}} = \sin^{-1} \left[ \frac{\sin \theta}{\sqrt{1 - \frac{a^2}{R_o^2}}} \right] \Big|_0^{\sqrt{1 - a^2/R_o^2}} = - \frac{\pi}{2} \quad (I67)$$

Finally we have

$$I_1 + I_2 = 2\lambda R_o \left\{ - \frac{\sqrt{\lambda^2 + 1}}{\lambda} \tan^{-1} \left[ \frac{\sqrt{\lambda^2 + 1}}{\lambda} \frac{\sqrt{1 - \frac{a^2}{R_o^2}}}{\frac{a}{R_o}} \right] + \cos^{-1} \left( \frac{a}{R_o} \right) - \frac{\pi}{2} \left[ \frac{\sqrt{\lambda^2 + 1 - \frac{a^2}{R_o^2}}}{\lambda} \right] + \frac{\pi}{2} \right\} \quad (I68)$$

#### 4.- Flow Field in Crossflow Plane Due to Deflection of a Single Panel on a Cruciform Wing-Body Combination

##### 4.1 Introduction

For a cruciform wing-body with no panel deflection, the flow field based on slender-body theory is given in section 2. However, the general flow field due to panel deflection is not known. From the results for single panel deflection, the effect of arbitrary deflections of all four panels can be obtained by superposition. This result will now be derived.

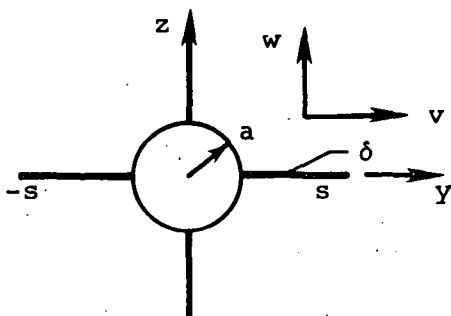
##### 4.2 Boundary Value Problem

Consider the cross section of a cruciform wing-body combination at zero roll angle and zero angle of attack but with the right fin deflected

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by angle,  $\delta$ , positive trailing edge down. The crossflow plane is designated by the complex variable

$$\tau = y + iz$$



The body radius is "a" and the fin semispan is "s". The vector velocity in the crossflow plane is  $v + iw$ , and the axial component of velocity is "u". Let the right panel be deflected by the angle  $\delta$  so that free-stream velocity  $V_\infty$  causes an uniform upwash  $V_\infty \sin \delta$  through the fin. We must find a potential  $\phi$  which produces equal and opposite downwash on the right fin and at the same time causes no flow normal to the other fins or the body. We then are to find the flow velocity components  $u$  and  $w$  at points  $x, y, z$  in the field due to this potential. The quantities  $a$  and  $s$  can be functions of  $x$ .

### 4.3 Method of Solution

The method of solution is to find the complex potential  $W$  which produces unit velocity at a given point on the deflected wing in the range  $a \leq y \leq s$  and zero at all other points. Then the effect of all such fundamental solutions over the range is summed by integration. The fundamental solution is that given by Adams and Dugan in reference 21. The velocity components are found by differentiation of  $W$ .

In obtaining the solution, recourse will be had to the theory of conformal transformation. In this connection let the cross-section of the cruciform wing-body combination in the  $\tau$  plane be transformed into a circle of radius  $R$  in the  $\sigma$  plane with

$$\sigma = \xi + i\eta \quad (I69)$$

Such a transformation is given as

$$\tau^2 + \frac{a^4}{\tau^2} = \sigma^2 + \frac{R^4}{\sigma^2} \quad (I70)$$

with

$$2R^2 = s^2 + \frac{a^4}{s^2} \quad (I71)$$

The reciprocal relationships between points in the  $\tau$  and  $\sigma$  planes are

$$\left. \begin{aligned} \sigma &= \frac{1}{2} \left\{ \sqrt{\left(\tau^2 + \frac{a^4}{\tau^2}\right) - 2R^2} + \sqrt{\left(\tau^2 + \frac{a^4}{\tau^2}\right) + 2R^2} \right\} \\ \tau &= \frac{1}{2} \left\{ \sqrt{\left(\sigma^2 + \frac{R^4}{\sigma^2}\right) - 2a^2} + \sqrt{\left(\sigma^2 + \frac{R^4}{\sigma^2}\right) + 2a^2} \right\} \end{aligned} \right\} \quad (I72)$$

In these relationships we confine our attention to the upper half plane. In equation (I70) we have put the fields at  $\infty$  into the identity relationship

$$\sigma \rightarrow \tau \text{ as } \tau \rightarrow \infty \quad (I73)$$

A point  $Re^{i\theta_0}$  on the circle  $Re^{i\theta}$  corresponds to  $y_0$  in the physical plane. From equation (I70)

$$2R^2 \left( \frac{e^{2i\theta_0} + e^{-2i\theta_0}}{2} \right) = y_0^2 + \frac{a^4}{y_0^2} \quad (I74)$$

so that

$$\frac{y_0^2}{R^2} = \cos 2\theta_0 + \sqrt{\left(\cos 2\theta_0 - \frac{a^2}{R^2}\right) \left(\cos 2\theta_0 + \frac{a^2}{R^2}\right)} \quad (I75)$$

and

$$\frac{y_0}{R} = \frac{1}{\sqrt{2}} \left[ \sqrt{\cos 2\theta_0 - \frac{a^2}{R^2}} + \sqrt{\cos 2\theta_0 + \frac{a^2}{R^2}} \right] \quad (I76)$$

If  $y_0 = s$ , then from equation (I74) and (I71)

$$2R^2 \cos 2\theta_0 = 2R^2$$



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or

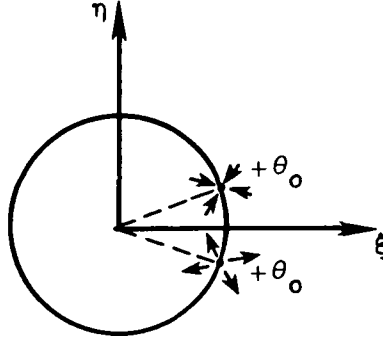
$$\theta_0 = 0; \quad y = s \quad (I77)$$

Let the point  $\text{Re}^{iY}$  correspond in the  $\sigma$  plane to  $y = a$  in the  $\tau$  plane. Then from equation (I74)

$$\cos 2Y = \frac{a^2}{R^2} \quad (I78)$$

### 4.4 Complex Potential

To obtain the complex potential for the fundamental solution, we follow the method of Adams and Dugan. Consider points on the upper and lower surfaces of the wing at  $y = y_0$  and consider a sink of strength  $dm$  at  $\text{Re}^{i\theta_0}$  and a source at point  $\text{Re}^{-i\theta_0}$  in the  $\sigma$  plane, corresponding to the two points at  $y=y_0$  in the  $\tau$  plane.



The complex potential for the sink is (assuming  $dm$  is positive)

$$dW_1 = -\frac{dm}{2\pi} \ln(\sigma - \text{Re}^{i\theta_0})$$

and for the pair, we have

$$dW = \frac{-dm}{2\pi} \ln \left( \frac{\sigma - \text{Re}^{i\theta_0}}{\sigma - \text{Re}^{-i\theta_0}} \right) \quad (I79)$$

It can be shown that the circle

$$\sigma = \text{Re}^{i\theta}$$

is a streamline of the complex potential given by equation (I79) although the points  $\text{Re}^{i\theta_0}$  and  $\text{Re}^{-i\theta_0}$  are singular points since many streamlines converge at these points, with a net mass flow through the circle at these points. Since  $\phi$  and  $\psi$  are equal at corresponding points in the  $\tau$  and  $\sigma$  planes in the conformal transformation of the flow, we can evaluate  $\psi$  on the wing panel in the  $\tau$  plane. Let the velocity components in the

$\tau$  plane be  $v$  and  $w$ . Then on the wing panel

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$$\frac{d\psi_o}{dy_o} = -w = + \delta V_\infty; \quad a \leq y_o \leq s \quad (I80)$$

Now since only half the source or sink flow passes through the fin

$$\frac{dm}{2} = \delta V_\infty dy_o \quad (I81)$$

and we have

$$dm = 2d\psi_o = 2\delta V_\infty dy_o \quad (I82)$$

Now summing all sources and sinks along both sides of the right panel between  $a \leq y_o \leq s$ , we have

$$W = -\frac{1}{\pi} \int_{\psi(a)}^{\psi(s)} \ln \left[ \frac{\sigma - Re^{i\theta_o}}{\sigma - Re^{-i\theta_o}} \right] d\psi_o \quad (I83)$$

Integrating by parts, yields

$$W(\sigma) = \frac{\psi(\gamma)}{\pi} \ln \left[ \frac{\sigma - Re^{i\gamma}}{\sigma - Re^{-i\gamma}} \right] - \frac{1}{\pi} \int_0^\gamma \psi(\theta_o) \frac{d}{d\theta_o} \left[ \ln \left[ \frac{\sigma - Re^{+i\theta_o}}{\sigma - Re^{-i\theta_o}} \right] \right] d\theta_o$$

$$W(\sigma) = \frac{\psi(\gamma)}{\pi} \ln \left[ \frac{\sigma - Re^{+i\gamma}}{\sigma - Re^{-i\gamma}} \right] - \frac{2iR}{\pi} \int_0^\gamma \frac{(\sigma \cos \theta_o - R) \psi(\theta_o) d\theta_o}{\sigma^2 - 2\sigma R \cos \theta_o + R^2} \quad (I84)$$

We now evaluate  $\psi_o$  by integrating equation (I80)

$$\psi_o = \delta V_\infty y_o + k \quad (I85)$$

where  $k$  is an arbitrary constant which we will set equal to zero. We thus find the complex potential

$$W(\sigma) = \frac{\delta V_\infty}{\pi} \left\{ a \ln \left[ \frac{\sigma - Re^{i\gamma}}{\sigma - Re^{-i\gamma}} \right] - i\sqrt{2} R^2 \int_0^\gamma \frac{(\sigma \cos \theta_o - R) \left[ \sqrt{\cos 2\theta_o - \frac{a^2}{R^2}} + \sqrt{\cos 2\theta_o + \frac{a^2}{R^2}} \right]}{(\sigma^2 - 2\sigma R \cos \theta_o + R^2)} d\theta_o \right\} \quad (I86)$$

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The expression of equation (I86) is the one which will be used to determine  $u$ ,  $v$  and  $w$ . Several approaches are possible. First we might consider  $\sigma$  as a real quantity, and integrate equation (I86) to obtain  $W(\sigma)$ . Then invoking the principle of analytical continuation, we would assume  $\sigma$  was complex again, and separate  $W(\sigma)$  into  $\phi$  and  $\psi$ . Differentiation of  $\phi$  then leads to  $u$ ,  $v$ , and  $w$ . This approach was tried and the part of the second integral involving  $\sqrt{\cos 2\theta_o - a^2/R^2}$  yields complete elliptical integrals of the third kind. The second part involving  $\sqrt{\cos 2\theta_o + a^2/R^2}$  yields incomplete elliptic integrals of the third kind. To separate such an incomplete elliptic integral into real and imaginary parts was considered too formidable a task so that an alternate approach was decided. In this approach  $W(\sigma)$  is differentiated, and an expression for  $V - iW$  is obtained. Complex integration then yields  $V$  and  $W$ , the velocity components in the  $\sigma$  plane.

### 4.5 Determination of $V$ and $W$

We will determine  $V$ , and  $W$  by carrying out the operation

$$V - iW = \frac{dW}{d\sigma} \quad (I87)$$

on equation (I86) and evaluating the complex integral. Carrying out the operations yields

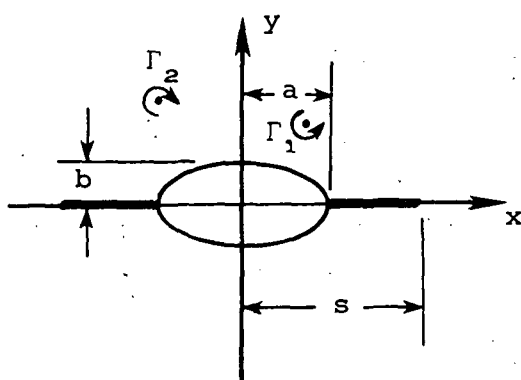
$$\begin{aligned} \frac{V - iW}{\delta V_\infty / \pi} &= \frac{a}{\sigma - Re^{i\gamma}} - \frac{a}{\sigma - Re^{-i\gamma}} \\ &+ i\sqrt{2} R^2 \int_0^\gamma \frac{[(\sigma^2 + R^2) \cos \theta_o - 2R\sigma] [\sqrt{\cos 2\theta_o + a^2/R^2} + \sqrt{\cos 2\theta_o - a^2/R^2}] d\theta_o}{(\sigma^2 - 2\sigma R \cos \theta_o + R^2)^2} \end{aligned} \quad (I88)$$

Equation (I88) is solved numerically.

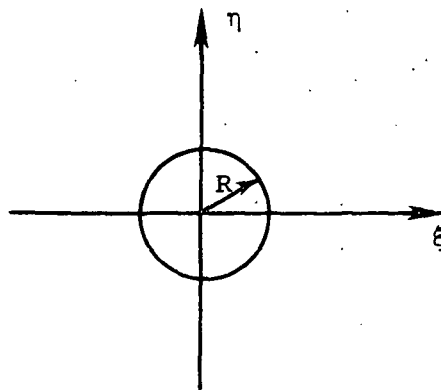
### 5.- Velocities on a Vortex Due to Other Vortices in the Crossflow Plane in the Presence of a Monoplane Midwing Mounted on a Body of Elliptic Cross-Section

#### 5.1 Conformal Mapping

As the first step in the analysis, we transform the elliptical configuration into a circle of radius  $R$ .



real plane:  $Z = x + iy$



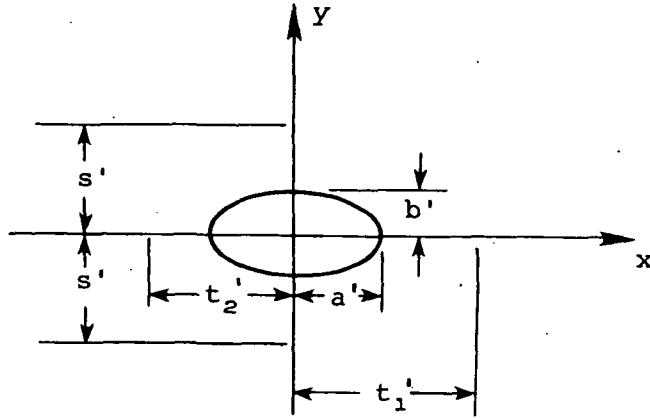
transformed plane:  $\zeta = \xi + i\eta$

Bryson (ref. 22) has presented the desired conformal mapping for an elliptical body with wings and vertical tail. Bryson's configuration is rotated  $90^\circ$  from the present one. The conformal mapping for the configuration shown below is:

$$Z = w + \frac{a'^2 - b'^2}{4w} \quad (\text{I89})$$

$$\left[ w + \frac{(a' + b')^2}{4w} \right]^2 = \left[ \frac{h-f}{2} + \zeta + \frac{(h+f)^2}{16\zeta} \right]^2 - k^2 \quad (\text{I90})$$

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where

$$k = \sigma - \left[ \frac{(a' + b')^2}{4\sigma} \right] \quad (\text{I91})$$

$$h^2 = k^2 + \left[ \tau_1 + \frac{(a' + b')^2}{4\tau_1} \right]^2 \quad (\text{I92})$$

$$f^2 = k^2 + \left[ \tau_2 + \frac{(a' + b')^2}{4\tau_2} \right]^2 \quad (\text{I93})$$

and

$$\sigma = \frac{1}{2} \left( s' + \sqrt{s'^2 + a'^2 - b'^2} \right) \quad (\text{I94})$$

$$\tau_1 = \frac{1}{2} \left( t_1' + \sqrt{t_1'^2 - a'^2 + b'^2} \right) \quad (\text{I95})$$

$$\tau_2 = \frac{1}{2} \left( t_2' + \sqrt{t_2'^2 - a'^2 + b'^2} \right) \quad (\text{I96})$$

For a configuration consisting of a monoplane midwing attached to the body with elliptical cross section (i.e. no vertical surfaces), we get the following special results.

$$t_1' = t_2' = s \quad (\text{I97})$$

$$a' = a \quad (\text{I98})$$

$$b' = b \quad (\text{I99})$$

$$s' = b' = b \quad (\text{I100})$$

In addition, we obtain

$$\tau_1 = \tau_2 = \frac{1}{2} \left( s + \sqrt{s^2 - a^2 + b^2} \right) \quad (\text{I101})$$

$$= \tau$$

$$\sigma = \frac{1}{2} (b + a) \quad (\text{I102})$$

$$k = \frac{1}{2} (a + b) - \frac{(a + b)^2}{2(a + b)} = 0 \quad (\text{I103})$$

$$h = f = \tau + \frac{\sigma^2}{\tau} \quad (\text{I104})$$

The required conformal mapping without the tail fins is

$$z = w + \frac{a^2 - b^2}{4w} \quad (\text{I105})$$

with

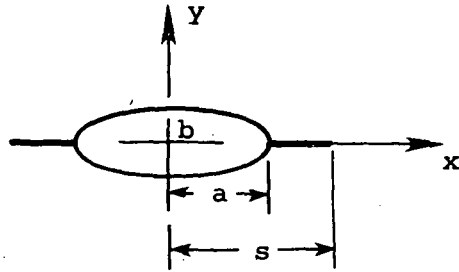
$$w + \frac{\sigma^2}{w} = \zeta + \frac{(h/2)^2}{\zeta} \quad (\text{I106})$$

where

$$\sigma = \frac{1}{2} (a + b) \quad (\text{I107})$$

$$h = \tau + \frac{\sigma^2}{\tau} \quad (\text{I108})$$

$$\tau = \frac{1}{2} \left( s + \sqrt{s^2 - a^2 + b^2} \right) \quad (\text{I109})$$



The radius of the circle in the transformed plane is

$$R = \frac{h}{2} = \frac{1}{4} \left[ s + \sqrt{s^2 - a^2 + b^2} + \frac{(a + b)^2}{s + \sqrt{s^2 - a^2 + b^2}} \right] \quad (\text{I110})$$

From equation (I106)

$$w = \frac{1}{2} \left\{ \zeta + \frac{(h/2)^2}{\zeta} \pm \sqrt{\left[ \zeta + \frac{(h/2)^2}{\zeta} \right]^2 - (a + b)^2} \right\} \quad (\text{I111})$$

also, from equation (I105)

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$$w = \frac{1}{2} \left( z + \sqrt{z^2 - a^2 + b^2} \right) \quad (I112)^*$$

and, from equation (I106)

$$\zeta = \frac{1}{2} \left[ w + \frac{\sigma^2}{w} \pm \sqrt{\left( w + \frac{\sigma^2}{w} \right)^2 - h^2} \right] \quad (I113)^*$$

The choice of signs in equations (I111) and (I113) will now be addressed. When evaluating these equations, use of the positive (+) sign will produce the correct result if the square root function is evaluated properly. The rule to follow in evaluating the square roots, is that the result should be a complex quantity in the same quadrant as the complex quantity appearing in the argument. This is particularly important if the original quantity is a negative real number. Thus, if:

$$\zeta + \frac{(h/2)^2}{\zeta} = -A$$

Then,

$$\left[ \zeta + \frac{(h/2)^2}{\zeta} \right]^2 - (a+b)^2 = A^2 - (a+b)^2$$

Assuming  $A^2 \gg (a+b)^2$ , the square root of this is positive, and  $\approx \pm A$ . Then, for equation (I111)

$$w \approx \frac{1}{2} [-A \pm A] = 0$$

This does not follow from equation (I106) which suggests that if  $\zeta + \frac{(h/2)^2}{\zeta}$  is large, then  $w$  should also be large. Thus, the proper solution of the square root would use the negative sign. In complex notation:

$$\zeta + \frac{(h/2)^2}{\zeta} = Ae^{i\pi}$$

Therefore,

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\* For body with elliptical cross section it can be shown that  $w = \zeta$ . Set  $s = a$  in equation (I110), then compare equations (I111) and (I113).

$$\begin{aligned} \left[ \zeta + \frac{(h/2)^2}{\zeta} \right]^2 - (a+b)^2 &= A^2 e^{i2\pi} - (a+b)^2 \\ &= \left[ A^2 - (a+b)^2 \right] e^{i2\pi} \end{aligned}$$

so that

$$\begin{aligned} \left[ \zeta + \frac{(h/2)^2}{\zeta} \right]^2 - (a+b)^2 &= \sqrt{A^2 - (a+b)^2} e^{i\pi} \\ &= -\sqrt{A^2 - (a+b)^2} \end{aligned}$$

## 5.2 Velocity of Vortex in Plane of Elliptical Wing-Body

In the circle plane, the complex potential for a set of vortices in the presence of the circle of radius  $R$  is given by equation (I5) as follows

$$\begin{aligned} w_1(\zeta) &= -\frac{i}{2\pi} \Gamma_0 \ln(\zeta - \zeta_0) + \frac{i}{2\pi} \Gamma_0 \ln \left( \zeta - \frac{R^2}{\zeta_0} \right) \\ &\quad - \frac{i}{2\pi} \sum_{j=1}^N \Gamma_j \ln \left( \frac{\zeta - \zeta_j}{\zeta - \frac{R^2}{\zeta_j}} \right) \end{aligned} \quad (I114)$$

To find the motion of vortex  $\Gamma_0$  in the  $z$  plane the proper complex potential must take account of the fact that  $\Gamma_0$  induces no velocity on itself

$$w_{\Gamma_0}(z) = w_1\left(\zeta(z)\right) + \frac{i\Gamma_0}{2\pi} \ln(z - z_0) \quad (I115)$$

The velocity of the vortex at  $z_0$  is then:

$$v_0 - iw_0 = \lim_{z \rightarrow z_0} \left\{ \frac{d}{dz} \left[ w_{\Gamma_0}(z) \right] \right\} \quad (I116)$$

Equation (I116) yields



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$$\begin{aligned} \frac{d}{dz} \left[ w_{\Gamma_0}(z) \right] &= \frac{d}{dz} \left[ -\frac{i}{2\pi} \Gamma_0 \ln \left( \frac{z - z_0}{z - z_0} \right) \right] + \frac{d}{dz} \left[ \frac{i\Gamma_0}{2\pi} \ln \left( z - \frac{R^2}{\bar{z}_0} \right) \right] \\ &\quad - \frac{i}{2\pi} \frac{d}{dz} \sum_{j=1}^N \Gamma_j \ln \left( \frac{z - z_j}{z - \frac{R^2}{\bar{z}_j}} \right) \end{aligned} \quad (I117)$$

The first term presents a problem which must be resolved by the following limiting process

$$\begin{aligned} -\frac{i\Gamma_0}{2\pi} \frac{d}{dz} \left[ \ln \left( \frac{z - z_0}{z - z_0} \right) \right] &= -\frac{i\Gamma_0}{2\pi} \left[ \frac{z - z_0}{z - z_0} \right] \left[ \frac{1}{z - z_0} \frac{dz}{dz} - \frac{z - z_0}{(z - z_0)^2} \right] \\ &= \frac{i\Gamma_0}{2\pi} \left[ \frac{1}{z - z_0} - \frac{1}{z - z_0} \frac{dz}{dz} \right] \end{aligned} \quad (I118)$$

Expand  $z$  in a Taylor series about  $z_0$ .

$$\begin{aligned} z &= z(z) \\ z - z_0 &= (z - z_0) \frac{dz}{dz} \Big|_{z_0} + \frac{1}{2} (z - z_0)^2 \frac{d^2 z}{dz^2} \Big|_{z_0} \\ &\quad + \frac{1}{6} (z - z_0)^3 \frac{d^3 z}{dz^3} \Big|_{z_0} + o(z - z_0)^4 \\ \frac{dz}{dz} - \frac{dz}{dz} \Big|_{z_0} &= (z - z_0) \frac{d^2 z}{dz^2} \Big|_{z_0} + \dots \end{aligned} \quad (I119)$$

Then

$$\begin{aligned} \frac{z - z_0}{z - z_0} &= \frac{dz}{dz} \Big|_{z_0} + \frac{1}{2} (z - z_0) \frac{d^2 z}{dz^2} \Big|_{z_0} + \frac{1}{6} (z - z_0)^2 \frac{d^3 z}{dz^3} \Big|_{z_0} \\ &\quad + o(z - z_0)^3 \end{aligned} \quad (I120)$$

Applying the limiting process to equation (I118), the result is

$$\begin{aligned}
 \lim_{z \rightarrow z_0} \left\{ -\frac{i\Gamma_0}{2\pi} \frac{d}{dz} \left[ \ln \frac{\zeta - \zeta_0}{z - z_0} \right] \right\} &= \frac{i\Gamma_0}{2\pi} \lim_{z \rightarrow z_0} \frac{1}{(\zeta - \zeta_0)} \left[ \frac{(\zeta - \zeta_0)}{z - z_0} - \frac{d\zeta}{dz} \right] \\
 &= \frac{i\Gamma_0}{2\pi} \lim_{z \rightarrow z_0} \frac{1}{\zeta - \zeta_0} \left[ \frac{1}{2}(z - z_0) \frac{d^2\zeta}{dz^2} \Big|_{z_0} + \frac{1}{6}(z - z_0)^2 \frac{d^3\zeta}{dz^3} \Big|_{z_0} + \dots \right. \\
 &\quad \left. - (z - z_0) \frac{d^2\zeta}{dz^2} \Big|_{z_0} - \dots \right] \quad (I121)
 \end{aligned}$$

by substitution from equation (I119) and (I120). Since

$$\lim_{z \rightarrow z_0} \frac{z - z_0}{\zeta - \zeta_0} = \frac{dz}{d\zeta} \Big|_{z_0} \quad (I122)$$

we finally obtain for the first term

$$\lim_{z \rightarrow z_0} \left\{ -\frac{i\Gamma_0}{2\pi} \frac{d}{dz} \left[ \ln \left( \frac{\zeta - \zeta_0}{z - z_0} \right) \right] \right\} = -\frac{i\Gamma_0}{2\pi} \frac{dz}{d\zeta} \Big|_{z_0} \frac{d^2\zeta}{dz^2} \Big|_{z_0} \quad (I123)$$

Carrying out the remaining differentiation yields an expression for the velocity at vortex  $\Gamma_0$  due to the other vortices

$$\begin{aligned}
 v_0 - iw_0 &= -\frac{i\Gamma_0}{4\pi} \frac{dz}{d\zeta} \Big|_{z_0} \frac{d^2\zeta}{dz^2} \Big|_{z_0} + \frac{i\Gamma_0}{2\pi} \frac{\bar{\zeta}_0}{\zeta_0 \bar{\zeta}_0 - R^2} \frac{d\zeta}{dz} \Big|_{z_0} \\
 &\quad - \frac{i}{2\pi} \sum_{j=1}^N \Gamma_j \left[ \frac{1}{\zeta_0 - \zeta_j} - \frac{\bar{\zeta}_j}{\zeta_0 \bar{\zeta}_j - R^2} \right] \frac{d\zeta}{dz} \Big|_{z_0} \quad (I124)
 \end{aligned}$$

### 5.3 Evaluation of Certain Derivatives

We now evaluate the derivatives  $\frac{dz}{d\zeta}$  and  $\frac{d^2\zeta}{dz^2}$  required in equation (I124). From equations (I105) and (I111)

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$$\frac{dz}{dz} = \frac{dz}{dw} \frac{dw}{dz} = \frac{1}{2} \left[ 1 - \frac{a^2 - b^2}{4w^2} \right] \left[ 1 - \frac{R^2}{\zeta^2} \right] \left[ 1 + \frac{\zeta + \frac{R^2}{\zeta}}{\sqrt{\left( \zeta + \frac{R^2}{\zeta} \right)^2 - (a+b)^2}} \right] \quad (I125)$$

From equations (I112) and (I113)

$$\frac{d\zeta}{dz} = \frac{d\zeta}{dw} \frac{dw}{dz} = \frac{1}{2} \left[ 1 - \frac{\sigma^2}{w^2} \right] \left[ 1 + \frac{w + \frac{\sigma^2}{w}}{\sqrt{\left( w + \frac{\sigma^2}{w} \right)^2 - h^2}} \right] \frac{dw}{dz} \quad (I126)$$

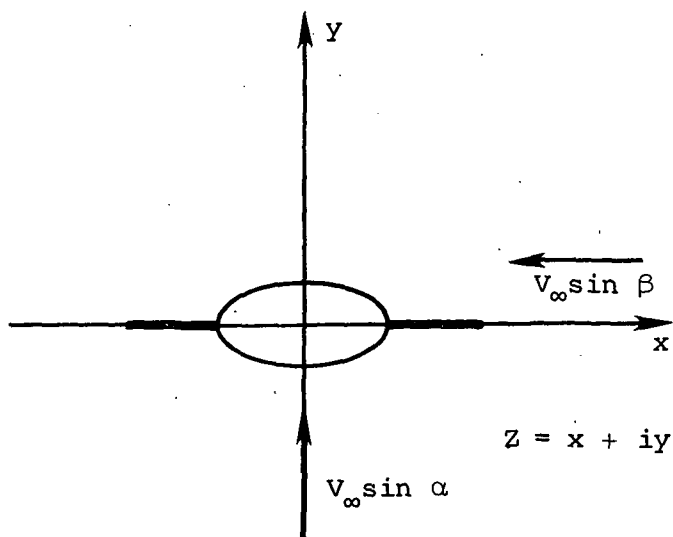
$$\frac{dw}{dz} = \frac{1}{2} \left[ 1 + \frac{z}{\sqrt{z^2 - a^2 + b^2}} \right] \quad (I127)$$

For the second derivative, we thus find

$$\begin{aligned} \frac{d^2\zeta}{dz^2} &= \frac{d}{dz} \left[ \frac{d\zeta}{dz} \right] = \frac{dw}{dz} \frac{d}{dw} \left[ \frac{d\zeta}{dz} \right] \\ &= \left( \frac{dw}{dz} \right)^2 \frac{d}{dw} \left[ \frac{1}{2} \left( 1 - \frac{\sigma^2}{w^2} \right) \left[ 1 + \frac{w + \frac{\sigma^2}{w}}{\sqrt{\left( w + \frac{\sigma^2}{w} \right)^2 - h^2}} \right] \right] \\ &= \left( \frac{dw}{dz} \right)^2 \left[ \frac{\sigma^2}{w^3} \left[ 1 + \frac{w + \frac{\sigma^2}{w}}{\sqrt{\left( w + \frac{\sigma^2}{w} \right)^2 - h^2}} \right] \right. \\ &\quad \left. - \frac{1}{2} \left( 1 - \frac{\sigma^2}{w^2} \right)^2 \frac{1}{\sqrt{\left( w + \frac{\sigma^2}{w} \right)^2 - h^2}} \left[ \frac{h^2}{\left( w + \frac{\sigma^2}{w} \right)^2 - h^2} \right] \right] \end{aligned} \quad (I128)$$

### 6.- Velocity Components in the Crossflow Plane Due to Pitch and Bank of a Monoplane Midwing Mounted on a Body of Elliptical Cross Section

The sketch below shows a monoplane wing mounted on a body with elliptical cross section. The upwash is  $V_\infty \sin \alpha$  and the sidewash is  $V_\infty \sin \beta$  in the negative x-direction.



Consider the transformation of the wing-body combination into a circle of radius  $R$  in the  $\zeta$  plane as described in section 5.1. For the pitch flow, the complex potential in the  $\zeta$  plane is:

$$W_\alpha(\zeta) = -i V_\infty \sin \alpha \left( \zeta - \frac{R^2}{\zeta} \right) \quad (1129)$$

The velocity in the  $Z$  plane is then

$$v_\alpha - iw_\alpha = \frac{dw}{dZ} = \frac{dw_\alpha}{d\zeta} \frac{d\zeta}{dZ}$$

or

$$v_\alpha - iw_\alpha = i V_\infty \sin \alpha \left( 1 + \frac{R^2}{\zeta^2} \right) \frac{d\zeta}{dZ} \quad (1130)$$

For the sideslip flow the complex potential in the  $\zeta$  plane is

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$$\begin{aligned}
 W_{\beta}(\zeta) &= -i V_{\infty} \sin \beta e^{-i\frac{\pi}{2}} \left( \zeta - \frac{R^2 e^{i\pi}}{\zeta} \right) \\
 &= -V_{\infty} \sin \beta \left( \zeta + \frac{R^2}{\zeta} \right)
 \end{aligned}
 \tag{I131}$$

The associated velocity components in the  $z$  plane are given by

$$v_{\beta} - iw_{\beta} = -V_{\infty} \sin \beta \left( 1 - \frac{R^2}{\zeta^2} \right) \frac{d\zeta}{d\bar{z}} \tag{I132}$$

## 7.- Velocities on a Vortex Due to Other Vortices in the Presence of a Monoplane Midwing Mounted on a Body of Elliptical Cross-Section Including Effects of Angles of Pitch and Sideslip

We follow the same conformal transformation described in section

5.1. The complete potential for the flow in the  $\zeta$  plane is

$$\begin{aligned}
 W[\zeta(z)] &= -i V_{\infty} \sin \alpha \left( \zeta - \frac{R^2}{\zeta} \right) + V_{\infty} \sin \beta \left( \zeta + \frac{R^2}{\zeta} \right) \\
 &\quad - \frac{i}{2\pi} \Gamma_0 \ln \left( \frac{\zeta - \zeta_0}{\bar{z} - \bar{z}_0} \right) + \frac{i}{2\pi} \Gamma_0 \ln \left( \zeta - \frac{R^2}{\bar{\zeta}_0} \right) \\
 &\quad - \frac{i}{2\pi} \sum_{j=1}^N \Gamma_j \ln \left( \frac{\zeta - \zeta_j}{\zeta - \frac{R^2}{\bar{\zeta}_j}} \right)
 \end{aligned}
 \tag{I133}$$

and the velocity at  $z_0$  is:

$$\begin{aligned}
 v_0 - iw_0 &= -i V_{\infty} \sin \alpha \left( 1 + \frac{R^2}{\zeta_0^2} \right) \frac{d\zeta}{d\bar{z}} \Big|_{z_0} + V_{\infty} \sin \beta \left( 1 - \frac{R^2}{\zeta_0^2} \right) \frac{d\zeta}{d\bar{z}} \Big|_{z_0} \\
 &\quad - \frac{i\Gamma_0}{4\pi} \frac{d\bar{z}}{d\zeta} \Big|_{z_0} \frac{d^2\zeta}{d\bar{z}^2} \Big|_{z_0} + \frac{i\Gamma_0}{2\pi} \frac{\bar{\zeta}_0}{\zeta_0 \bar{\zeta}_0 - R^2} \frac{d\zeta}{d\bar{z}} \Big|_{z_0}
 \end{aligned}$$

(equation continued on next page)

$$- \frac{i}{2\pi} \sum_{j=1}^N \Gamma_j \left[ \frac{1}{\zeta_0 - \zeta_j} - \frac{\bar{\zeta}_j}{\zeta_0 \bar{\zeta}_j - R^2} \right] \frac{d\zeta}{dz} \Big|_{z_0} \quad (I134)$$

The derivatives  $\frac{dz}{d\zeta}$  and  $\frac{d^2\zeta}{dz^2}$  are given in section 5.3.

### 8.- Velocity Components in the Crossflow Plane Due to Expansion of a Body With Elliptical Cross Sections

Assume that the expansion occurs with constant  $a/b$  ratio. Equation (4-30) of reference 8 gives the desired complex potential

$$W_1(z) = \frac{S'}{2\pi} \ln \frac{z + \sqrt{z^2 - a^2 + b^2}}{2} \quad (I135)$$

$$S = \pi ab$$

$$a = a(x)$$

$$b = b(x)$$

If  $\frac{a}{b} = 1/k$  then  $S = \pi k a^2$  and  $S' = 2\pi k a a' = 2\pi k a \frac{da}{dx}$ .

Carrying out the differentiation yields the velocity components.

$$\begin{aligned} v - iw &= \frac{dw}{dz} = \frac{S'}{2\pi} \frac{2}{z + \sqrt{z^2 - a^2 + b^2}} \left( \frac{1}{2} + \frac{2z}{2(2)\sqrt{z^2 - a^2 + b^2}} \right) \\ &= \frac{S'}{2\pi} \frac{1}{z + \sqrt{z^2 - a^2 + b^2}} \left( \frac{\sqrt{z^2 - a^2 + b^2} + z}{\sqrt{z^2 - a^2 + b^2}} \right) \\ &= \frac{S'}{2\pi} \frac{1}{\sqrt{z^2 - a^2 + b^2}} \end{aligned} \quad (I136)$$

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### DESCRIPTION OF PROGRAM DEMON2

The purpose of this appendix is to describe the supersonic lifting surface-body computer program in sufficient detail to permit understanding and use of the program. The present program is an extended and improved version of a pre-existing wing-body program as described in section 1 of this report.

Program DEMON2 computes pressure distributions on lifting surfaces and along the meridians of the body if it is circular in cross section. In this case, the program is equipped with body nose shed vorticity data modeled by two symmetric, discrete potential flow vortices. The effects of this vorticity are accounted for in the calculation of pressures on the body and lifting surfaces. If the body is elliptical in cross section, program WDYBDY described in Appendix K is employed to model the body and to compute pressures acting on it. Program WDYBDY also serves as a companion to DEMON2 for the purpose of calculating body induced velocities at the control points on the lifting surfaces through an exchange of data sets. The lifting surfaces can be cruciform canard fins or cruciform tail fins, a monoplane wing or interdigitated tail fins. For all but the last case, edge vorticity characteristics are calculated by the program.

By repeated application, program DEMON2 in conjunction with other programs can be employed to handle complete configurations including forward and tail lifting surfaces mounted on bodies with circular or elliptical cross section. Detailed descriptions of the required procedures are given in section 5.

The theoretical basis of program DEMON2 and its usage will first be summarized. Configuration parameters taken into consideration are listed. The general calculation procedure is given and it is followed by a description of the program operation. Program limitations and precautions are pointed out. The input required and the output generated by the program are described. Program listings appear at the end of this appendix.

#### Program Description

Fundamentally, the program is based on representing the lifting surfaces by constant u-velocity panels and the body with circular cross section by a distribution of line sources/sinks and doublets along its

centerline. Fin or wing thickness effects are modeled by planar source panels. The body source/sink and doublet strengths are determined explicitly from the flow tangency condition at points on the body surface. The body singularities and body nose vorticity, if applicable, induce velocity components at points on the lifting surfaces. The strengths of the constant u-velocity panels associated with the lifting surfaces and those laid out in a shell around the body to account for interference are obtained from a set of simultaneous equations which result from applying the flow tangency condition at a finite set of control points distributed over the lifting surfaces and interference shell. Thus, mutual interference between one lifting surface and another and between the lifting surfaces and the body are fully accounted for. Further details are given in section 2 and 3 of this report. 1

If the body is elliptical in cross section, a companion program designated WDYBDY, described in Appendix K, models the body using body source panels. In the main routine CRFWBD of program DEMON2, the effects induced by the body source panels and body nose vorticity, if applicable, are included in the flow tangency condition applied at points on the lifting surfaces. The program has been arranged to allow for an interference shell with elliptical cross section. The lifting surfaces attached to this shell can be a monoplane wing or a set of interdigitated tail fins. Mutual interference is accounted for in the manner described above. Refer to section 4 for more detail.

In the case involving an axisymmetric body, the program first treats the forebody and the forward or canard-body section. Effects of body nose vortices can be included in the calculation of pressures on the body and fins. The afterbody and tail fins are treated by another application of this program. Effects of body nose vortices and the canard edge vortices can be included in the calculated pressures acting on the aft body and loads on the tail fins. A separate program VPATH2, based on slender-body theory and described in Appendix L, is employed to determine the vortex paths along the complete configuration from the leading edge of the canard section back to the body base. The required procedure is described in section 5.1.

When the body is elliptical in cross section, the program first treats the forward or monoplane wing-body section. The forebody is



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handled by program WDYBDY. Effects of body nose vortices can be accounted for in the calculation of pressures on the body and the monoplane wing. The part of the body between the monoplane wing and tail section is handled also by program WDYBDY. The interdigitated tail-body section is treated by another application of program DEMON2. Effects of body nose and monoplane wing edge vortices can be included in the calculated pressures acting on the afterbody and on the interdigitated tail fin-body section. A separate program VPATHL, based on slender-body theory and described in Appendix L, is used to track vortices from the leading edge of the monoplane wing section to the leading edge of the interdigitated tail section. Section 5.2 describes the required procedure in detail.

As far as the lifting surface sections are concerned, program DEMON2 computes pressure distributions, forces and moments including effects of external vortices, if applicable. The pressures on the fins or wing are calculated on the basis of linear and Bernoulli pressure relationships. For all cases except those including interdigitated tails, leading- and side-edge suction distributions are calculated for the purpose of modeling separation vorticity characteristics at these edges using Polhamus' analogy as described in Appendix C. At the trailing edges, one or more concentrated vortices are computed from the span load distribution using the method described in Appendix B.

Two calculative examples are described in section 6. It should be noted here that the program can also treat wings or fins alone. However, axisymmetric bodies alone cannot be handled. In the latter case, the program can still be used to obtain forebody pressures by including a set of artificial lifting surfaces at the base of the body of interest. Note that the program WDYBDY treats bodies alone. However, in the application of WDYBDY to axisymmetric bodies, computation time far exceeds the time required by program DEMON2 on account of the different type and number of singularities used to represent the body.

### Geometrical Characteristics

Program DEMON2 contains the subroutines required to flow model bodies with circular cross section. The body is composed of a nose section followed by a cylindrical section. The nose section may have the following shapes (the choice is set by control index BCODE in namelist \$BODY

read in by subroutine BDYGEN):

	<u>Forebody Shape</u>
BCODE = 0	Parabolic
= 1	Sears-Haack*
= 2	Tangent-ogive
= 3	Ellipsoidal
= 4	Conical

The geometrical characteristics of the lifting surfaces that can be accounted for include the following:

Leading-edge shape:	Straight line which may be swept or it can be composed of straight line elements with different sweeps.
Trailing-edge shape:	Straight line which may be swept or it can be composed of straight line elements with different sweeps.
Thickness:	Accounted for by specifying streamwise slopes (not applicable to interdigitated tails).
Taper:	Uniform or broken.
Mean camber surface:	Planar.
Side edges:	Streamwise (not essential).
Dihedral:	Arbitrary, set by angle PHIDIH (see figure 3).
Location of interference shell:	Arbitrary, set by angle THETIT (see figure 3).

The lifting surfaces can be cruciform canard fins, cruciform tail fins, a monoplane wing or a set of interdigitated tails. In all instances, there must be a vertical plane of symmetry ( $y_B = 0$  plane) as far as the geometry is concerned.

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\* Ashley, H. and Landahl, M.: Aerodynamics of Wings and Bodies, Addison-Wesley Publishing Co., Inc., 1965, pp. 180-181.

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### Calculation Procedure

Program DEMON2 proceeds through various stages as follows. After reading in the run identification, namelist \$INPUT is read in by main routine CRFWBD. Basically, this list contains wing or fin geometry data, flow conditions, geometry specifications for the interference shell and specifications for the distribution of constant u-velocity panels on the fin and the shell. In addition, moment-center coordinates and the vortex lift factors are specified. The wing- and body-coordinate systems are shown in figures 1 and 2.

The wings or fins of any fin-body combination are covered with a constant u-velocity panel layout with the panel side edges parallel to the fin root chords which, in turn, are made to be parallel to the body centerline. An optional input allows for unequal spanwise spacing of the side edges and breaks in sweep. The actual construction of the panel sweeps, centroid and control point coordinates is performed in subroutine LAYOUT. All coordinates are expressed in the  $x_w$ ,  $y_w$ ,  $z_w$  or wing coordinate system. Coordinate transformations relating a fin coordinate system with origin on the fin rootchord to the wing coordinate system are implemented in subroutine LAYOUT by means of function statements FYROT and FZROT. Subroutine LAYOUT also computes the geometrical characteristics of the body interference panels. Note that the leading and trailing edges of the interference panels are unswept, see figure 1.

As an option, the above process is repeated in subroutine THKLYT for the layout of planar source panels. They are used to account for thickness associated with the wings or fins of a cruciform, planar but not an interdigitated configuration such as the combination shown in figure 3. Streamwise thickness slopes are read in by subroutine THKIN. Depending on the procedural steps described in section 5, main routine CRFWBD can write a data set containing the coordinates, in the wing coordinate system, of the control points associated with the wings or fins and the interference shell. If control index NCPOUT is set equal to 2 in namelist \$INPUT, the run is stopped at this stage. Otherwise, the program continues as follows.

If the body is circular in cross section, main routine CRFWBD calls subroutine BDYGEN. This subroutine proceeds to read in namelist \$BODY

which contains body nose length and length of body to be modeled as well as control indices governing the number of line singularities distributed along the body centerline and the shape of the body nose. The layout and strengths of the line sources/sinks and line doublets employed to flow model the body are then computed for the flow conditions read in by name-list \$INPUT. Main routine CRFWBD then calls subroutine BDYPR which computes pressure distributions at points along the meridians on the body with circular cross section. The Bernoulli pressure, equation (10), is used for this purpose on this process, effects of body nose vorticity and body line singularities are accounted in the pressures calculated on the forebody. Over the length of body covered by the lifting surfaces, the pressures are computed at the control points of the body interference panels in the interference shell. This is performed following entry point BDYAFT after the panel strengths are calculated. The velocity components used in the pressure calculation include contributions from the body line singularities, external vortices and constant u-velocity and source panels distributed over the fins or wings. The effects of external vortices (such as body nose vortices) can be accounted for on the basis of the vortices moving parallel to the body centerline (subroutine VRTVEL) or the vortices moving in the crossflow plane (program VPATH2 or VPATHL). Subroutine BDYPR also calculates the pressures on the length of body between the forward and aft lifting surface sections.

Velocity components induced by line singularities associated with the axisymmetric body at the control points on the lifting surfaces and interference shell are calculated by subroutine VELCAL. These components will be used in the flow tangency condition applied at points on the lifting surfaces and in the calculation of pressures at points on the lifting surfaces and the interference shell.

For cases involving bodies with elliptical cross sections, main routine CRFWBD calls subroutine BDYRD which reads in velocity components induced by the body source panels at the control points distributed over the lifting surfaces and interference shell. These velocities will be used in the flow tangency condition applied at the control points on the lifting surfaces and the calculation of pressures at points on the lifting surfaces and the interference shell.

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Routine CRFWBD continues with the construction of the influence coefficient matrix associated with the constant u-velocity panels laid out on the lifting surfaces and the interference shell. In this process, subroutine VELNOR performs the superposition of 4 corner solutions associated with a trapezoidal, constant u-velocity panel. For each corner subroutine VELO computes the influence of a semi infinite triangle. If the flow conditions dictate symmetry in loading (w.r.t. the  $y_B$  (or  $y_W$ ) = 0 plane), subroutine VELNOR also accounts for the influence of the constant u-velocity panels on the opposite side of the plane of symmetry. Appendix A contains a discussion concerning the superposition scheme and the symmetry account.

The aerodynamic influence matrix, designated FVN, consists of the left-hand sides of equations (1) through (5) in section 3.4 and is triangularised by subroutine LINEQS. The right-hand sides of these equations are formed as a single column matrix designated RHS. For the control points on the lifting surfaces, the latter contains contributions from the free stream (including effect of deflection angle), body singularities (line singularities or source panels) and external vortices if applicable. For the control points on the interference shell, the right-hand side only contains contributions from the planar source panels modeling thickness of the lifting surfaces. These contributions are calculated by a call to subroutine THKVEL. Note that thickness effects are not accounted for if the lifting surfaces are interdigitated tails.

In the determination of velocity components normal to the panels on the lifting surfaces, transformations from the reference or wing coordinate system to the fin coordinate system are required. Subroutine ROTATE with entry points ROTWF and ROTFW contains the rotational coordinate transformation described in Appendix D. These transformations are used in the determination of normal velocity components as indicated in Appendix E and apply to cruciform, monoplane and interdigitated lifting surface configurations. Likewise, velocity transformations are performed from the reference or wing coordinate system to the local body interference panel coordinate system. These transformations are performed in subroutine TRBIPW with entry points TRWBIP (for coordinates), ROTBW and ROTWB (for velocities). The angles associated with the transformations

are indicated in figure 3. The velocity transformations apply to both the left- and right-hand sides of equations (1) through (5).

Main routine CRFWBD then calls subroutine SOLVE which takes the triangulated aerodynamic influence coefficient matrix, FVN, generated by LINEQS and the single column matrix, RHS, and proceeds to solve for the unknown strengths of the constant u-velocity panels.

Subroutine LOADS is then called to compute forces and moments acting on the lifting surfaces and the interference shell. Transformations from the local fin or body interference panel coordinate system to the reference or wing coordinate system are performed for the force and moment coefficients. For example, the force acting normal to the fins must be resolved into the  $y_W$  or  $y_B$  and  $z_W$  or  $z_B$  directions associated with the wing or body coordinate systems. The procedure is described in Appendix F. Note that the force and moment transformations also apply to monoplane or cruciform lifting surface configurations. The forces and moments are calculated in the body coordinate system and then transformed into the wind axis coordinate system in accordance with equations (18) and (19). These equations appear in section 4.2 in connection with calculations performed in program WDYBDY and apply to subroutine LOADS of program DEMON2 as well.

The loads acting on the interference shell calculated by subroutine LOADS represent only the lift carryover from the lifting surfaces to the body and may include interference due to fin or wing thickness. The pressures acting on the interference shell calculated by subroutine BDYPR (through entry point BDYAFT) include effects not only from the lifting surfaces but also include contributions from body singularities and external vortices if applicable. As such the pressures are indicative of the total load acting on the body over the length covered by the lifting surfaces.

Subroutine LOADS calculates the fin and interference shell loads first on the basis of linear pressure. This is followed by a call to subroutine SPECPR from subroutine LOADS to compute pressures acting on the lifting surfaces using the Bernoulli pressure equation (10). The loads acting on the lifting surfaces are then recalculated on the basis of the Bernoulli pressures.

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If the lifting surfaces do not form an interdigitated fin configuration, subroutine LOADS calls subroutine SPNLD for the purpose of calculating spanload distributions, leading- and side-edge suction distributions. Using the span loading information, the strength and spanwise location of the concentrated trailing-edge vortices are calculated in accordance with Appendix B. The vorticity characteristics associated with the leading and side edges are determined from the suction distributions as described in Appendix C.

### Program Operation

The cruciform wing-body computer program is written in the FORTRAN IV language (029 punch) and has been run on the CDC 6600 machine belonging to Boeing Computer Services, Inc. The main program is arranged so that a total of 250 constant u-velocity panels is available to cover the wing surfaces and to be used as body interference panels. A total of 100 sources and 100 doublets can be used to model the body. If the program is to be run on a different computer with smaller core memory, dimension statements need to be changed to permit operation on that machine.

In addition to the standard input and output tapes (TAPE5=INPUT, TAPE6=OUTPUT), the program may require additional devices such as disc files or tapes for storing data sets generated when certain options are used. One data set would consist of a set of control point coordinates and the other would contain a set of perturbation velocities. Devices used for these purposes are TAPE4 and TAPE7. The program employs a system-supplied subroutine REQFL which computes the actual dimension requirement for the aerodynamic coefficient matrix FVN. This subroutine makes use of special machine-dependent parameters. Certain other systems may have a similar subroutine available. If no such subroutine is available, the dimension of array FVN should be set to 62,500 and the four calls to REQFL marked in the main program removed.

Additional system-supplied devices used by the main program are the BUFFER OUT and BUFFER IN options. They are used as an option to save the triangulated aerodynamic influence matrix FVN associated with the fins and body interference shell. TAPE3 is used for this purpose. This procedure saves time when calculations are done for a given configuration at some Mach number but with different included angles of attack or roll.

However, the pertinent calls should be removed from the main program if other systems do not offer such devices.

Program DEMON2 treats one set of lifting surfaces on a body. In order to handle complete configurations involving forward and tail lifting surfaces, the program must be used in a stepwise manner in conjunction with other programs described in this report. A detailed description of the required procedure is given in section 5.

Running time required by program DEMON2 is governed by the number of constant u-velocity panels laid out on the lifting surfaces. For a pitched and rolled cruciform wing-body combination employing 192 constant u-velocity panels and 22 sources/sinks and doublets, the running time on the CDC 6600 is about 60 seconds for one set of flow conditions.

#### Program Limitations and Precautions

There are some problems that could arise in the use of the cruciform wing-body program. It should be noted that subroutines LOADS, BDYPR, VRTVEL, ROTATE and TRBIPW contain entry points. The first does not employ an argument list and should not cause any problems. However, the entry points in the second, third, fourth and fifth may need to have the appropriate subroutine argument list attached to them if other computer machines are used.

A warning is concerned with the use of system subroutine REQFL and the BUFFER devices already mentioned above under program operation. If the subroutine is not available, an equivalent subroutine can be called or the calls to REQFL can be removed and the dimension on FVN set to 62,500. Similarly, if the BUFFER devices are not system supplied, calls to them in the main program should be removed.

In the specification of the number of constant u-velocity panels to be distributed on the fins and body in namelist \$INPUT, the following limits must be kept in mind. For the fins, a maximum of 150 panels are available. In the spanwise direction, the maximum number of panels is 19. The number of body interference panels must not exceed 100. Finally, the total number of panels on the fins and interference shell cannot exceed 250. In namelist \$BODY, the number of sources/sinks and the number of doublets (both specified by NXBODY) cannot exceed 100.



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Care must be taken with the use of control indices NOUT and NPR. A very large amount of additional output is generated when these indices are set equal to one. This output should only be used for debugging purposes employing a minimum number of constant u-velocity panels such as two per fin and four on the circumference of the body interference shell with two in the lengthwise direction.

A maximum magnitude is set by the program for the perturbation velocities induced by external vortices at the control points in the flow tangency condition. Since these velocities are based on potential vortex theory, their values could assume large magnitudes if the vortices run close to the fins and cause undue influence. Consequently, their magnitude is limited to 0.35. This value can be overridden by setting variable VRTMAX in namelist \$INPUT equal to the desired value.

At the present time, program DEMON2 computes pressure distributions on the body surface and lifting surfaces of complete configurations in conjunction with other programs as described in section 5. The program also determines the force and moment coefficients associated with the lifting surfaces but it does not compute the forces and moments acting on the body if it is circular in cross section. The latter quantities can be determined by an integration of the program calculated pressure distributions. In this connection, the program calculated forces and moments associated with the interference shell only represent the effects of lift carryover from the lifting surfaces to the body although effects of thickness may be included. The actual loads acting on the part of the body in the lifting surface section can also be determined from the pressure distributions.

Span load and suction distributions and the associated edge vorticity characteristics are not calculated for interdigitated fins at this time. Thickness effects are also not accounted for this type of lifting surface configuration.

### Description of Input

This section describes the input for program DEMON2 for treating one set of lifting surfaces on a body. In the following discussion, the content of all input cards is summarized. All possible input variables

are listed at the end of this section in the order of appearance in the input deck, except for the first four variables which do not appear in the input deck but are needed for program input preparation. Sample inputs are discussed in section 6 concerned with the calculative examples. Note that the correspondence in designation between interdigitated fins and cruciform fins is indicated in figure 3 and also referred to in item 2 below.

#### Item 1

The first card serves as identification and may contain any alphanumeric information desired. This information is printed on the first page of the output.

#### Item 2

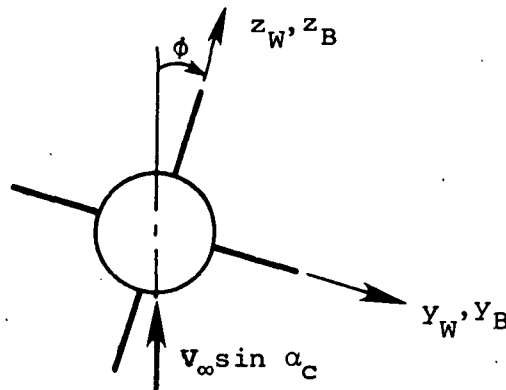
The second and following cards form the namelist \$INPUT which specifies the geometrical parameters of the wing surfaces and interference shell. These parameters are the leading-edge and trailing-edge sweeps, semispan and rootchord. For a planar wing or cruciform wing alone, the rootchord is the wing centerline or the cruciform wing junction. In the case of a wing-body combination, the rootchord is the line formed by the junction of the lifting surface and the body. The semispan is measured from the rootchord in any case.

This namelist also contains the deflection angles and the number of chordwise and spanwise constant u-velocity panels for each lifting surface. The spanwise number may differ from one fin to another but the chordwise number NCW is the same for all. Similar information is specified for the layout of planar source panels. The number of body interference panels, NBD CR, on the circumference are also included in this namelist. The specification of the latter also determines whether or not a body is present. The number of body interference panels in the axial direction is specified by NCWB. The body can be cylindrical or elliptical in cross section over the interference length, BIL, spanned by the lifting surfaces. If the interference shell is elliptical, the horizontal semi-axis RB and vertical semi-axis RA must be specified. The ratio RB/RA must equal ERATIO. If the interference shell is circular, set RB equals RA and ERATIO equals 1. If the lifting surfaces are delta wings (unswept trailing edges), length BIL equals the rootchord CRP. If the trailing edges are

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swept back, the length BIL should be extended to include the trailing edge of the tip chord to account properly for the interference of the lifting surfaces on the body.

The included angle of attack, ALFAC, is the angle between the free stream and the body/wing centerline ( $x_B$ -axis in figure 1). Angle of roll, PHI, is indicated by  $\phi$  in the sketch below. The program computes pitch and sideslip angles in accordance with the pitch-roll transformation mentioned in section 4 of this report.



Setting control index NDRAG equal to 1 results in the calculation of in-plane forces (Appendix C) acting on the lifting surfaces. At the present time, this is not possible when the lifting surfaces form an interdigitated configuration and NDRAG should be set equal to 0 (the default value) for this case.

In addition, more control indices, free-stream Mach number, and reference quantities SREF and REFL are read in. Breaks in leading-edge and/or trailing-edge sweeps are also allowed if the configuration is a wing or cruciform wing alone at zero sideslip or if the configuration consists of a monoplane or cruciform or interdigitated wing-body. This option is governed by control index LVSWP. Angles SWLEP, SWTEP, SWLEV, and SWTEV need not be specified if LVSWP  $\neq$  0.

Indices NCPOUT, NVLIN, ITAIL, JCPT play an important part in the procedural use of program DEMON2 as described in section 5 in this report. Quantities FKLE and FKSE are the vortex lift factors discussed in Appendix C. The axial location of the moment center, XM, must be specified in the body coordinate system with origin at the nose.

Angles PHIDIH and THETIT are indicated on figure 3 and apply to monoplane and interdigitated lifting surface configurations. Note that the correspondence in designation between interdigitated fins and cruciform fins is indicated in figure 3. It is also referred to in connection with the fin deflection angles listed under item 2.

### Item 3

This optional input is required when there are breaks in the wing sweep or if the constant u-velocity panel side edges are to be laid out with user-determined unequal spanwise spacings. This input pertains only to a wing or cruciform wing alone at zero sideslip. Variable YR is the distance from the rootchord to the outboard panel side edges. Therefore, the first value for YR is zero. The last value for YR must equal wing semispan, B2, specified in the namelist \$INPUT. In effect, this specification positions the panel outboard side edges on the right wing. The sweep angles are positive for wings with sweptback leading and trailing edges.

### Item 4

The optional input of this item is associated with a wing-body combination with breaks in leading-edge and/or trailing-edge sweeps. Also, this input should be used for this configuration if the constant u-velocity panel side edges are to be laid out with user-determined unequal spacings. Variable YRT is the distance from the wing rootchord to the outboard constant u-velocity panel edges on the right wing or fin. The first value should equal 0.0 and the last value for YRT equals the semispan, B2; the latter is specified in the namelist \$INPUT. The sweep angles are positive for right wings or fins with sweptback leading and trailing edges.

### Item 5

This optional input accompanies Item 4 and is associated with the left wing or fin. Variable YLT is the distance from the wing rootchord to the outboard constant u-velocity panel edges on the left wing or fin. The first value should equal 0.0 and the last value for YLT equals the negative semispan, -B2. The sweep angles are negative for left wings or fins with sweptback leading and trailing edges.

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### Item 6

The information in this optional item accompanies Items 4 and 5 if the configuration is a cruciform or interdigitated wing-body combination. Again, this input should only be used if there are breaks in the wing or fin sweeps or if the panel side edges are to be laid out with user-determined unequal spacings. Variable ZUT is the distance from the wing rootchord to the outboard constant u-velocity panel edges on the upper wing or fin. The first value should equal 0.0 and the last equals the semispan, B2V. The latter is specified in namelist \$INPUT. The sweep angles are positive for upper wings or fins with sweptback leading and trailing edges.

### Item 7

This optional information is the last of four inputs associated with a cruciform or interdigitated wing-body combination if there are breaks in sweep or if the constant u-velocity panel side edges are to be laid out with user determined spacings; see Items 4 through 6. Variable ZDT is the distance from the wing rootchord to the outboard constant u-velocity panel edges on the lower wing or fin. The first value should equal 0.0 and the last value for ZDT must equal -B2V. The sweep angles are negative for lower wings or fins with sweptback leading and trailing edges.

### Item 8

This item is concerned with the specification of the layout and strengths of the planar source panels employed to model thickness of the lifting surfaces. If the case at hand involves interdigitated lifting surfaces, this item must be omitted in the input (NTDAT=0). Basically, the planar source panels are laid out in the same manner used to layout the constant u-velocity panels. However, in this case the distance out to the outboard panel edge is now measured from the body centerline not the rootchord of the lifting surface under consideration. Breaks in sweep are handled by control index LVSWT in the same way control index LVSWP handled breaks in sweep in the layout of constant u-velocity panels.

The strengths of the planar source panels are related directly to the streamwise slopes and must be specified a priori. An example of such

a specification is shown in section 6.2.. Note that quantity THET is in fact the tangent of the thickness envelope angle,  $\tan \theta_s$ .

#### Item 9

The input cards for this item form the namelist \$BODY which is required only when a body with circular cross section is part of the configuration under consideration. If the integer NBDRCR in namelist \$INPUT under Item 2 is specified to be nonzero, and RB equals RA, a body with circular cross section is present. The information in this input includes specification of body geometry parameters and is read in by subroutine BDYGEN. The length of the nose, LNOSE, determines the body length over which the radius is changing as a function of the body axial coordinate. The actual nose configuration is governed by control index, BCODE, which selects preprogrammed forebody shapes described above in this appendix.

Normally, the body length, LBODY, should at least equal the axial distance from the body nose to the trailing edges of the lifting surfaces under consideration. If the trailing edges are sweptback, length LBODY should be taken to include the trailing edge of the tip chords or side edges of the lifting surfaces at hand.

The minimum number of body modeling singularities NXBODY should be determined as follows. Let the density (sources and doublets/unit body length) be determined by the number of constant u-velocity panels in the chordwise direction on the wing divided by the rootchord (or length of wing-body junction). Then, number NXBODY equals the density times body length.

#### Item 10(a)

This input is required only when variable NVRTX specified in namelist \$INPUT, Item 2, is nonzero and if the body is circular in cross section. In fact, NVRTX is the number of external, two-dimensional vortices whose influences are to be included in the pressure and loading calculations. Each vortex is assumed to be infinite in length and to be parallel to the body centerline. Therefore, with each vortex there is associated a non-dimensional strength, GAMMA, and nondimensional crossflow plane coordinate, YVRTX, ZVRTX, given in the body or wing coordinate system shown in figure 1. These quantities are input in subroutine VRTVEL.

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### Item 10(b)

This input is required only when variable NVRTX specified in namelist \$INPUT, Item 2, is nonzero and if the body is elliptical in cross section. As in item 10, each vortex is assumed infinite in length and to be parallel to the body centerline. In this case, the strength GAMMA is  $\Gamma/V_\infty$ , and YVRTX and ZVRTX are the coordinates expressed in the wing coordinate system for each vortex. This information is read in by main routine CRFWBD.

### Items 11, 12, 13, 14

The information specified in these items pertain to leading- and side-edge vorticity characteristics. If specified in the input, their influence would influence the pressures and loads on the lifting surfaces and the interference shell under consideration. Presently, it is not recommended to include edge vorticity effects associated with a lifting surface in the calculation of the loading acting on the same lifting surface. Thus, a blank card can be inserted for items 11 and 13.

### Item 15

This card ends the process of reading in data for program DEMON2. It should only be put at the end of all data cards for the case(s) to be run. The computer program stops the search for more data and the run is finished.

#### INPUT VARIABLES, PROGRAM DEMON2

The terms "right and "left" refer to an observer looking forward.

<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
MSWRP	Definitions of terms used below	(Number of chordwise rows on right wing) + 1; MSWRP = MSWR + 1.
MSWLP		(Number of chordwise rows on left wing) + 1; MSWLP = MSWL + 1.
MSWUP		(Number of chordwise rows on upper wing) + 1; MSWUP = MSWU + 1.
MSWDP		(Number of chordwise rows on lower wing) + 1; MSWDP = MSWD + 1.

<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
<u>Item 1</u>	(20A4)	Any alphanumeric information may be put on this card for identification of the calculation.
<u>Item 2</u>		Namelist \$INPUT.
CRP	$c_{r,H}$	Horizontal wing rootchord, dimensional.
SWLEP	$\Lambda_{LE,H}$	Horizontal wing leading-edge sweep angle measured in wing planform, positive for sweep back, degrees.
SWTEP	$\Lambda_{TE,H}$	Horizontal wing trailing-edge sweep angle measured in wing planform, positive for sweep back, degrees.
NCW		Number of chordwise constant u-velocity panels on the wing.
MSWR		Number of spanwise constant u-velocity panels on right wing; $1 \leq \text{MSWR} \leq 19$ .
MSWL		Number of spanwise constant u-velocity panels on left wing; $1 \leq \text{MSWL} \leq 19$ , default is 0.
MSWU		Number of spanwise constant u-velocity panels on the upper wing; $1 \leq \text{MSWU} \leq 19$ , default is 0.
MSWD		Number of spanwise constant u-velocity panels on the lower wing; $1 \leq \text{MSWD} \leq 19$ , default is 0. <u>Note:</u> When running symmetric case <u>do not</u> include vertical surfaces. Set NCRX = 0 MSWL = 0 MSWU = 0 MSWD = 0
SWLEV	$\Lambda_{LE,V}$	Vertical wing leading-edge sweep angle measured in wing planform positive for sweep back, degrees, default is 0.0.
SWTEV	$\Lambda_{TE,V}$	Vertical wing trailing-edge sweep angle measured in wing planform, positive for sweep back, degrees, default is 0.0.
CRPV	$c_{r,V}$	Vertical wing rootchord, dimensional, default is 0.



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<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
B2	$b_H/2$	Exposed horizontal wing semispan, dimensional.
B2V	$b_V/2$	Exposed vertical wing semispan, dimensional, default is 0.0.
RA	b	Vertical semi-axis for body with elliptical cross section.
RB	a	Horizontal semi-axis for body with elliptical cross section.
ERATIO	a/b	Ratio of RB over RA <u>Note:</u> If body has circular cross section set RA = RB and ERATIO = 1.0.
BIL		Length of body influenced by fins to account for interference. For fins with delta planform and for wing-alone cases, BIL = CRP.
NFVNPR		NFVNPR $\neq$ 0 Print influence coefficient matrix FVN for debugging, default is 0.0.
NOLINP		NOLINP = 0 Loadings calculated on the basis of linear pressures only, default value. NOLINP = 1 Loadings calculated on the basis of linear and Bernoulli pressures.
NOUT		NOUT $\neq$ 0 Print large amount of output for debugging, default is 0.0.
NPR		Same as NOUT, default is 0.0.
NDRAG		NDRAG = 0 Omit calculation of in-plane forces, default value. NDRAG = 1 Include calculation of in-plane forces. Use default value when treating interdigitated tails.
FAC		FAC = 0.95 Fraction of the constant pressure panel chord (which contains the centroid) where the control point is located.
TOLFAC		TOLFAC = 1 Multiplication factor used in the evaluation of the tolerance, TLRNC, used in subroutine VELO.

<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
NPRESS		NPRESS = 0 This value insures that loadings are also computed on the basis of the linear pressure relationship in addition to the Bernoulli pressure relationship.
VRTMAX		Maximum magnitude of vortex induced velocities included in flow tangency condition, default is 0.35.
NVRTPL		NVRTPL = 0 Component of velocity parallel to fin induced by vortices not included in Bernoulli loading pressure, default value. NVRTPL = 1 Loading pressure calculated including parallel component of vortex induced velocity.
NAGAIN		NAGAIN = 0 No use made of buffer to save aerodynamic influence matrix, FVN, after triangulation, default value = 0. NAGAIN = 1 Buffer out FVN array. For succeeding runs, keep NAGAIN = 1.
DELRR	$\delta_{H,R}$	Deflection angle of horizontal right wing. Positive: trailing edge down, degrees, default is zero.
DELL	$\delta_{H,L}$	Deflection angle of horizontal left wing. Positive: trailing edge down, degrees, default is 0.0.
DELU	$\delta_{V,U}$	Deflection angle of vertical upper wing. Positive: trailing edge to right, degrees, default is 0.0.
DELD	$\delta_{V,D}$	Deflection angle of vertical lower wing. Positive: trailing edge to right, degrees, default is 0.0.
		If case involves <u>interdigitated fins</u> :
	$\delta_{H,R}$	applies to right upper fin, trailing edge down is positive.
	$\delta_{H,L}$	applies to left lower fin, trailing edge down is positive.
	$\delta_{V,U}$	applies to right lower fin, trailing edge down is positive.
	$\delta_{V,D}$	applies to left upper fin, trailing edge down is positive.
ALFAC	$\alpha_c$	Included angle of attack, measured between free-stream velocity vector and body/wing centerline.

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<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
PHI	$\phi$	Angle of roll, measured from the plane containing the free-stream velocity vector and the body/wing centerline to the upper wing, positive clockwise looking forward, default is 0.0.
FMACH	$M_{\infty}$	Free-stream Mach number.
LVSWP		LVSWP = 0 No breaks in wing leading or trailing edges, or equal spanwise spacings of panel side edges, default value. LVSWP $\neq$ 0 Up to 19 breaks in wing leading or trailing edges or up to 19 unequal spanwise spacings.
NVRTX		Number of external vortices present, NVRTX $\leq$ 10 (see Item 10(a)).
NCRX		NCRX = 0 Horizontal wing only present, default value. NCRX = 1 Vertical wing surfaces in addition to horizontal wing surfaces present.
NBDCR		Number of constant u-velocity panels on the circumference of the body. NBDCR = 0 No body present, default value. NBDCR > 0 Body present (see Item 8).
NCWB		Number of constant u-velocity panels in the longitudinal direction on the surface of the body over the body interference length BIL, default is 0.0.
SREF	$S_{ref}$	Reference area used in load calculations, default is 1.
REFL	$l_{ref}$	Reference length used in rolling-moment calculations, default is 1.
ITAIL		ITAIL = 1 Tail fins to be considered, default is 0. If case involves interdigitated fins mounted on body with elliptic cross section set ITAIL = 0.
NBDYPR		NBDYPR = 1 Pressures to be calculated along body meridians, default is 0.

<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
NTPR		NTPR = 1 Print debug output from subroutine THKVEL, default is 0.
NTDAT		Number of sets of thickness data to be input. Set NTDAT=0 for cases involving interdigitated fins. NTDAT = 0 No thickness input data, default value. NTDAT = 1 For horizontal wing, symmetric layout <u>or</u> for cruciform wing, symmetric layout with layout on vertical wings same as on horizontal wings. NTDAT = 2 For cruciform wing, symmetric layout. Vertical wing layout different from horizontal <u>or</u> for horizontal wing alone (delta wing) with asymmetric layout. NTDAT = 4 For cruciform wing alone (delta wing), asymmetric layout.
NCWT		Number of source panels in a chordwise row, default is 0.
NCPOUT		NCPOUT = 0 No control point coordinates written, default value. NCPOUT = 1 Write coordinates (in wing coordinate system) of control points on fin and body interference shell in data set (TAPE4), and continue the run. NCPOUT = 2 Write coordinates (in wing coordinate system) of control points on fin and body interference shell in data set (TAPE4) and stop the run (STOP77).
NVLIN		NVLIN = 0 Do not read in velocity components induced by moving vortices. NVLIN = 1 Read in velocities induced by moving vortices (calculated by program VPATH2 or VPATHL) from a data set (TAPE7), default is 0.
XSTART		Axial station aft of which body pressures are to be calculated. If case involves interdigitated tails on body with elliptic cross section, set XSTART = 0.0, default is 0.0.

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<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
JCPT		Number of control points and body pressure points calculated by subroutine BDYPR and printed in output. This number is required when NVLIN = 1 and ITAIL = 1, default is 0.
FKLE		Fraction of leading-edge suction converted into normal force, default is 0.5.
FKSE		Fraction of side-edge suction converted into normal force, default is 0.5.
XM		x-coordinate of moment center in body coordinate system, default is 0.0.
ZM		z-coordinate of moment center in body coordinate system, default is 0.0.
PHIDIH	$\phi_F$	Dihedral angle associated with interdigitated fin, default is 0.0, $0 \leq \phi_F < 90^\circ$ .
THETIT	$\theta$	Location angle associated with interdigitated fin, default is 0.0, $0 \leq \theta < 90^\circ$ .
XWLE		Axial location of wing rootchord leading edge measured from body nose, default is 0.0.
<u>Item 3</u>	(3F10.5)	Optional input for planar or cruciform wing alone at zero sideslip.
YR(KJ)	$y_{W,R}$ (KJ)	Distance from wing rootchord to the constant pressure panel outboard side edge on right wing, $1 \leq KJ \leq MSWRP$ , (MSWRP $\leq 30$ ), YR(1) = 0.0, YR(MSWRP) = B2.
VSWLER(KJ)	$\Lambda_{LE,R}$ (KJ)	Leading-edge sweep of wing between YR(KJ-1) and YR(KJ), positive for sweep back, degrees, $1 \leq KJ \leq MSWRP$ , (MSWRP $\leq 20$ ), VSWLER(1) = 0.0.
VSWTER(KJ)	$\Lambda_{TE,R}$ (KJ)	Trailing-edge sweep of wing between YR(KJ-1) and YR(KJ), positive for sweep back, degrees. $1 \leq KJ \leq MSWRP$ , (MSWRP $\leq 20$ ), VSWTER(1) = 0.0.
<u>Item 4</u>	(3F10.5)	Optional input for wing-body combination.
YRT(KJ)	$y_R$ (KJ)	Distance from wing rootchord to the constant u-velocity panel outboard side edge on right wing, $1 \leq KJ \leq MSWRP$ , (MSWRP $\leq 20$ ), YRT(1) = 0.0, YRT(MSWRP) = B2.

<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
VSWLER(KJ)	$\Lambda_{LE,R}^{(KJ)}$	Leading-edge sweep of wing between (YRT(KJ-1) and YRT(KJ)), positive for sweep back, degrees, $1 \leq KJ \leq MSWRP$ , ( $MSWRP \leq 20$ ), VSWLER(1) = 0.0.
VSWTER(KJ)	$\Lambda_{TE,R}^{(KJ)}$	Trailing-edge sweep of wing between (YRT(KJ-1) and YRT(KJ)), positive for sweep back, degrees, $1 \leq KJ \leq MSWRP$ , ( $MSWRP \leq 20$ ), VSWTER(1) = 0.0.
<u>Item 5</u>	(3F10.5)	Optional input for wing-body combination.
YLT(KJ)	$Y_{W,L}^{(KJ)}$	Distance from wing rootchord to the con- stant u-velocity panel outboard side edge on left wing, $1 \leq KJ \leq MSWLP$ , ( $MSWLP \leq 20$ ), YLT(1) = 0.0, YLT(MSWLP) = -B2.
VSWLEL(KJ)	$\Lambda_{LE,L}^{(KJ)}$	Leading-edge sweep of wing between YLT(KJ-1) and YLT(KJ), negative for sweep back, degrees, $1 \leq KJ \leq MSWLP$ , ( $MSWLP \leq 20$ ), VSWLEL(1) = 0.0.
VSWTEL(KJ)	$\Lambda_{TE,L}^{(KJ)}$	Trailing-edge sweep of wing between YLT(KJ-1) and YLT(KJ), negative for sweep back, degrees, $1 \leq KJ \leq MSWLP$ , ( $MSWLP \leq 20$ ), VSWTEL(1) = 0.0.
<u>Item 6</u>	(3F10.5)	Optional input for cruciform wing-body combination.
ZUT(KJ)	$z_{W,U}^{(KJ)}$	Distance from wing rootchord to the con- stant u-velocity panel outboard side edge on upper wing, $1 \leq KJ \leq MSWUP$ , ( $MSWUP \leq 20$ ), ZUT(1) = 0.0, ZUT(MSWUP) = B2V.
VSWLEU(KJ)	$\Lambda_{LE,U}^{(KJ)}$	Leading-edge sweep of wing between ZUT(KJ-1) and ZU(KJ), positive for sweep back, degrees, $1 \leq KJ \leq MSWUP$ , ( $MSWUP \leq 20$ ), VSWLEU(1) = 0.0.
VSWTEU(KJ)	$\Lambda_{TE,U}^{(KJ)}$	Trailing-edge sweep of wing between ZUT(KJ-1) and ZUT(KJ), positive for sweep back, degrees, $1 \leq KJ \leq MSWUP$ , ( $MSWUP \leq 20$ ), VSWTEU(1) = 0.0.

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PROGRAM VARIABLE	ALGEBRAIC SYMBOL (IF APPLICABLE)	COMMENTS
<u>Item 7</u>	(3F10.5)	Optional input for cruciform wing-body combination.
ZDT(KJ)	$z_{W,D}(KJ)$	Distance from wing rootchord to the constant u-velocity panel outboard side edge on lower wing, $1 \leq KJ \leq MSWDP$ , ( $MSWDP \leq 20$ ), $ZDT(1) = 0.0$ , $ZDT(MSWDP) = -B2V$ .
VSWLED(KJ)	$\Lambda_{LE,D}(KJ)$	Leading-edge sweep of wing between $ZDT(KJ-1)$ and $ZDT(KJ)$ , negative for sweep back, degrees, $1 \leq KJ \leq MSWDP$ , ( $MSWDP \leq 20$ ), $VSWLED(1) = 0.0$ .
VSWTED(KJ)	$\Lambda_{TE,D}(KJ)$	Trailing-edge sweep of wing between $ZDT(KJ-1)$ and $ZDT(KJ)$ , negative for sweep back, degrees, $1 \leq KJ \leq MSWDP$ , ( $MSWDP \leq 20$ ), $VSWTED(1) = 0.0$ .
<u>Item 8</u>		Optional thickness input data when $NTDAT \neq 0$ . If case involves interdigitated fins, this option is not used.
<u>Item 8(a)</u>	(3I5)	Information in items 8(a), 8(b) are read in by subroutine THKIN for the right horizontal wing.
MSWT		Number of source panels in the spanwise direction, $1 \leq 19 \leq MSWT$ .
LVSWT		LVSWT = 0 No breaks in wing leading or trailing edges, or equal spanwise spacings of source panel sides, default is 0. LVSWT = 1 Up to 19 breaks in wing leading or trailing edges or up to 19 unequal spanwise spacings.
NUNIS		NUNIS = 1 Thickness distribution varies over the span. NUNIS = 0 Thickness distribution constant over the span.
<u>Item 8(b)</u>	(3F10.0)	Optional input for LVSWT = 1.
YTH(1,J)		Distance from body centerline to the source panel outboard side edge, $1 \leq J \leq MSWT+1$ .

<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
SWLET(J)		Leading-edge sweep of wing between YTH(1,J-1) and YTH(1,J), positive for sweep back, degrees, $1 \leq J \leq \text{MSWT}+1$ .
SWTET(J)		Trailing-edge sweep of wing between YTH(1,J-1) and YTH(1,J), positive for sweep back, degrees, $1 \leq J \leq \text{MSWT}+1$ .
<u>Item 8(c)</u>	(8F10.0)	Optional input specifying streamwise thickness slopes read in by subroutine THETIN.
THET(K)	$\tan \theta_s$	NUNIS = 1    K = 1, NWCT NUNIS = 0    K = 1, (NCWT*MSWT)
<u>Item 8(d)</u>		Optional input for left wing when body is not present and if geometric yaw angle is accounted for (skewed panels). All input same as for right wing above, items 8(a), 8(b), and 8(c).
<u>Item 8(e)</u>		Optional input for upper wing if NTDAT = 2 or 4 and NCRX = 1. Same input as for right wing, items 8(a), 8(b) and 8(c).
<u>Item 8(f)</u>		Optional input for lower wing if NCRX = 1 and body is not present and if geometric pitch angle is accounted for (skewed panels). All input same as for right wing, items 8(a), 8(b) and 8(c).
<u>Item 9</u>		Namelist \$BODY read in by subroutine BDYGEN. Optional input when body with circular cross section is present, NBDCR $\neq$ 0.
NXBODY		Number of line source/sinks and line doublet singularities distributed along body centerline.
LNOSE		Length of nose part of body measured from nose tip, dimensional (real variable).
LBODY		Length of body, dimensional (real variable).



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PROGRAM VARIABLE	ALGEBRAIC SYMBOL (IF APPLICABLE)	COMMENTS
BCODE		Control index (integer) for specifying forebody shape.  BCODE = 0    Parabolic = 1    Sears-Haack = 2    Tangent ogive = 3    Ellipsoidal = 4    Conical
<u>Item 10(a)</u>	(8F10.5)	Optional input read by subroutine VRTVEL when the effect of fixed external vortices are considered, for bodies with circular cross section only (RB = RA), $1 \leq NVRTX \leq 10$ .
GAMMA(I)	$\frac{\Gamma}{2\pi V_\infty a}$ (I)	Nondimensional vortex strengths, a is body radius RB, $1 \leq I \leq NVRTX$ .
YVRTX(I)	$\frac{y(I)}{a}$	Nondimensional y-coordinate, $1 \leq I \leq NVRTX$ .
ZVRTX(I)	$\frac{z(I)}{a}$	Nondimensional z-coordinate, $1 \leq I \leq NVRTX$ .  There will be NVRTX sets of vortex inputs.
<u>Item 10(b)</u>	(3F10.5)	Optional input when the effect of fixed external vortices are considered, for bodies with elliptical cross section only (RB $\neq$ RA), $1 \leq NVRTX \leq 10$ .
GAMMA(I)	$\frac{\Gamma}{V_\infty}$ (I)	Vortex strength divided by free stream velocity, $1 \leq I \leq NVRTX$ .
YVRTX(I)	$y_w(I)$	y-coordinate in wing coordinate system of I'th vortex, $1 \leq I \leq NVRTX$ .
ZVRTX(I)	$z_w(I)$	z-coordinate in wing coordinate system of I'th vortex, $1 \leq I \leq NVRTX$ .  There will be NVRTX sets of vortex inputs.
<u>Item 11</u>	(8I10)	
MLEVR		Number of leading-edge vortex information stations for the right horizontal fin.
MLEVL		Number of leading-edge vortex information stations for the left horizontal fin.

<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
MLEVU		Number of leading-edge vortex information stations for the upper vertical fin.
MLEVD		Number of leading-edge vortex information stations for the lower vertical fin.
<u>Item 12</u>	(6F10.5)	Optional input concerning leading-edge vorticity when MLEVR+MLEVL+MLEVU+MLEVD = NLEEV $\neq$ 0.
XLE(IFV)	$x_{w,LE}$	Wing x-coordinate of station of fin leading edge.
CGLOC(IFV)	$\bar{y}_{LE}, \bar{z}_{LE}$	Center of gravity of the leading-edge vorticity distribution.
GAMLE(IFV)	$\frac{\Gamma_{LE}}{V_{\infty}}$	Strength of the vorticity distribution at XLE(IFV), $1 \leq IFV \leq NEDGV$ .
<u>Item 13</u>	(I10)	
NSEV		Number of fin side-edge vortex information stations. Same for all fins.
<u>Item 14</u>	(6F10.5)	Optional input concerning side-edge vorticity when 4(NSEV) = NSIDGE $\neq$ 0.
XSE(JSE)	$x_{w,SE}$	Wing x-coordinate of station on fin side edge.
CGSELC(JSE)	$\bar{y}_{SE}, \bar{z}_{SE}$	Center of gravity of the side-edge vorticity distribution.
GAMSE(JSE)	$\frac{\Gamma_{SE}}{V_{\infty}}$	Strength of vorticity distribution at XSE(JSE), $1 \leq JSE \leq NSIDGE$ .
<u>Item 15</u>	(20A4)	
ZZZZ		End of information.

## Description of Output

This section gives a summarized description of the output generated by program DEMON2 for a typical case involving one set of lifting surfaces on a body. Sample outputs are shown in connection with the discussion of 2 sample cases in section 6. In the following, the important items of output are described. Note that if print control indices NOUT and NPR are not set equal to zero in namelist \$INPUT, very large output will be generated. As such, this additional output serves to aid in debugging.

The first page identifies the run. The second and possibly the third show the namelist \$INPUT. All length dimensions in the output are the same as in the input.

On the next page, the wing geometry and flow conditions are listed. The quantities ALFA and BETA correspond to angle of pitch,  $\alpha$ , and side-slip,  $\beta$ , respectively, calculated by the program, using the pitch-bank convention described in section 4, from the angle of incidence ALFAC and angle of roll PHI specified in namelist \$INPUT. Information concerning the geometrical layout of the planar source panels used to model thickness of the lifting surfaces is then shown. On the next page, the specified streamwise slopes are printed. No thickness is accounted for for cases including interdigitated lifting surfaces.

If the body is circular in cross section, the next page shows namelist \$BODY which was read in by subroutine BDYGEN. It is followed by the program calculated cylindrical coordinates of the body definition points and streamwise body slopes. Together with this body geometry output, the origin of each line singularity (line sources/sinks and line doublets) are given under the heading TX. All axial coordinates are in the body coordinate system with origin at the nose, refer to figure 1. The strengths of the singularities are given by T(I) for the line sources or sinks and by TC(I) for the line doublets. On the next pages, the output shows the pressures calculated on the circumference of the body with circular cross section. This information is calculated at axial locations under the heading XB in the body coordinate system. Each circumference or ring is given a BODY RING number which is written on top of the pressure point coordinates, the velocity component involved, pressure coefficients, body slopes, and pressure ratios. The pressures are

calculated by subroutine BDYPR on the basis of the linear and Bernoulli pressure-velocity relationships. The latter is given by equation (10) in this report. If the pressures are calculated on the forebody, body nose shed vorticity characteristics can appear in the output if the included angle of attack is in excess of about  $5^\circ$ . The vorticity is represented by 2 concentrated vortices located symmetrically with respect to the crossflow free-stream component vector (unrolled coordinates). The vortex coordinates are also given in the body coordinate system (rolled coordinates) nondimensionalized by the local body radius. The calculated pressures include effects of the body nose vortices, if present. At the end of the print out of the pressures acting on the body, the number of control points, JCPT, is written. This number must be noted for runs involving the afterbody and tail fins, refer to sections 6.1.3 and 6.1.4.

For bodies with elliptical cross section, the horizontal and vertical semiaxes are printed immediately following the print out of local surface slope of the thickness distribution. Pressures at points on the surface of a body with elliptical cross section are calculated by program WDYBDY described in Appendix K.

The next pages of output contain the velocity components induced by external vortices, if applicable. They are calculated by program VPATH2 for axisymmetric bodies or by program VPATHL for bodies with elliptic cross section. Both programs are described in Appendix L. These programs compute the paths of the vortices and then proceed to calculate the vortex induced velocity components at the control points given under the headings XCP, YCP and ZCP.

The next page in the output lists the calculated control point coordinates ( $x_w, y_w, z_w$ ) in the wing coordinate system shown in figure 1 for the constant u-velocity panels distributed on the lifting surfaces. Perturbation velocities, in the wing coordinate system, induced at these points by the body and external vortices with their paths fixed to be parallel to the body centerline are also shown. The quantities BU, BV, BW and VVRTX, WVRTX, are due to body singularities and vortices specified in Item 10(a) or 10(b) of the input. The velocity components induced by the body singularities are calculated by subroutine VELCAL if the body is axisymmetric. For bodies with elliptic cross section, they are computed by program WDYBDY, stored on a data set and read in by subroutine BDYRD.

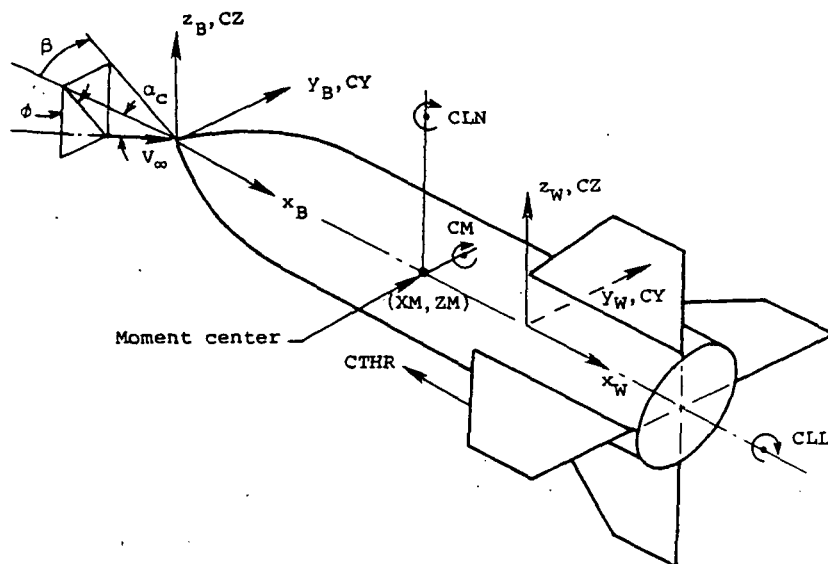
## APPENDIX J

Coordinates of the control points associated with the body interference panels are given on the next page. They are expressed in the wing coordinate system. Velocity components  $THU(J)$ ,  $THV(J)$  and  $THW(J)$  are induced by the planar source panels on the lifting surfaces used to model thickness.

Loading information is printed on the next pages. First, the loadings are based on linear pressure loadings. For each lifting surface the force and moment coefficients, spanwise loading and suction distributions and distributions along the side edge of suction force are given. The heading specifies flow conditions and reference quantities including the moment-center coordinates in the body system. It is followed by a list of the deflection angle, thrust coefficient,  $CTHR$ , acting in the negative  $x_B$  (or  $x_W$ ) direction, force coefficient  $CZ$  in the  $z_B$  (or  $z_W$ ) direction, force coefficient  $CY$  in the  $y_B$  (or  $y_W$ ) direction, pitching moment  $CM$  (nose up positive), yawing moment  $CLN$  (nose to right positive) and rolling-moment  $CLL$  (right wing down positive) coefficients.

Force coefficients  $CZ$ ,  $CY$  and moment coefficients  $CM$ ,  $CLN$  and  $CLL$  are also printed for the interference shell which covers the body over the length covered by the lifting surfaces. They are only representative of the lift carryover or interference from the lifting surfaces. If actual loads acting on this section of body are to be computed, the pressure distributions mentioned at the end of this section must be integrated.

So far, the loading coefficients have been expressed in the body axis system. For convenience, the positive directions of the forces and moments in the body coordinate system are indicated in the following sketch together with the body and wing reference coordinate systems. The loading information is also specified in the wind axis system, refer to section 4.2 in this report. All force and moment coefficients are then based on a coordinate system with its longitudinal axis aligned with the free stream vector. Under the heading **SPANWISE DISTRIBUTIONS**, the quantities of interest are the span loading  $CN^*C/(2*B)$ , thrust distribution  $CT^*C/(2*B)$ , suction distribution  $CS^*C/(2*B)$  and the calculated leading-edge vorticity strength  $GAMMA_{LE}/VIN^*$  with its spanwise location  $YBAR$ . Quantity  $XLE$  is the axial coordinate, in the wing system, of the leading edge. The sums of the in-plane forces in coefficient form are then printed. Precise definitions of the terms  $SUMFX$ ,  $SUMFY1$ , etc., are



given in Appendix C. Along the side edge, the distribution of suction force per unit length divided by the dynamic head times the tip chord is given together with the strength  $\text{GAMMA}_{SE}/V_{\infty}$  of the side-edge vorticity and the spanwise location  $Y_{BAR}$ . Quantity  $Y_{BAR}$  lies along the  $y_W$  coordinate. Finally, for the lifting surface at hand the strength(s) and spanwise location(s) of the concentrated trailing-edge vortex (vortices) are printed under the heading T.E. FIN INFO.

After displaying the loading information and spanwise distributions for all the lifting surfaces, the output of program DEMON2 proceeds to specify pressure distributions on the lifting surfaces calculated on the basis of the Bernoulli pressure expression, equation (10). PRESSA is the pressure coefficient acting on the upper side and PRESSB is the pressure coefficient on the lower side of the horizontal lifting surface. For a planar (monoplane) and cruciform fin or wing configuration, the horizontal surfaces lie in the  $z_W$  (or  $z_B$ ) = 0 plane. For interdigitated fins, the horizontal fins are the right upper and left lower fins, refer also to figure 3 and the sketch in Appendix D. Coordinates  $X(J)$ ,  $Y(J)$  and  $Z(J)$  are in the wing coordinate system. The same pressure coefficient information is given for the vertical fins. For a cruciform fin configuration, the vertical surfaces lie in the  $y_W$  (or  $y_B$ ) = 0 plane. For interdigitated fins, the vertical fins are the right lower and left upper fins, refer to figure 3 and the sketch in Appendix D. The loading pressures coefficients,  $\text{DELTP}_{LIN.}$  and  $\text{DELTP}_{BERN.}$ , pertain to the differences in

## APPENDIX J

pressures acting on the lifting surfaces based on linear and Bernoulli pressure expressions, respectively.

The loading calculation is then repeated using the Bernoulli loading pressures. The next pages of output contain the same loading information described above but all results are now based on the Bernoulli pressure equation.

The calculation of loading information based on linear pressure loadings and Bernoulli pressure loadings serves the following purposes. It should be noted first that the linear loading pressures are directly related to the constant u-velocity panel strengths in accordance with equation (C2) in Appendix C whereas the Bernoulli pressures are computed from the velocity components, included angle of attack and roll angle as indicated by equations (9) and (10). Fin forces, moments and trailing edge vorticity characteristics (related to span load distributions as shown in Appendix B) should be taken from the loading information calculated with Bernoulli pressures. At low angles of attack with zero roll and in the absence of external vorticity, the loadings based on the two pressures will be comparable. However, any loading increment due to leading- and side-edge vorticity calculated with the Polhamus analogy must be taken from the loading information based on linear pressures. This is based on the fact that the characteristics of the leading- and side-edge vorticity are related to the suction distributions which is calculated using the constant u-velocity panel strengths as described in Appendix C.

Finally, the pressures acting at the control points of the body interference shell are printed out. They are a continuation of the pressures, described at the beginning of this section, calculated at points on the body ahead of the wing-body section at hand. The same remarks apply. The pressures include effects of body singularities, external vortices, planar source panels on the lifting surfaces, and all the constant u-velocity panels on the lifting surfaces and body interference shell.

### Program Listing

The wing-body program DEMON2 is written in FORTRAN IV (029 punch) computer language for the CDC 6600 machine. The program consists of a main routine, CRFWBD and 32 subroutines. Their listings are shown on pages indicated below.

## PROGRAM DEMON2

ROUTINE	ADDITIONAL ENTRIES	IDENTIFICATION Cols. 73-76	PAGE NO.
1	CRFWBD	DMN01	179
2	BDYGEN	02	196
3	BDYPR	03	201
4	BDYRD	04	207
5	BDYVTX	05	208
6	BODYR	06	209
7	DBLU	07	210
8	DOUBLT	08	211
9	DSDZ	09	212
10	EDGES	10	212
11	EDGVOR	11	212
12	LAYOUT	12	216
13	LINEQS	13	223
14	LOADS	14	224
15	OUT	15	235
16	ROTATE	16	235
17	SOLVE	17	236
18	SOURCE	18	236
19	SPECPR	19	237
20	SPNLD	20	242
21	THETIN	21	253
22	THKIN	22	254
23	THKLYT	23	255
24	THKOUT	24	258
25	THKVEL	25	260
26	TRBIPW	26	266
27	VELCAL	27	267
28	VELNOR	28	268
29	VELO	29	276
30	VELOTH	30	279
31	VRTVEL	31	282
32	VVELS	32	284
33	Z	33	285



## PROGRAM DEMON2

	PROGRAM CRW80(INPUT,OUTPUT,TAPE3,TAPE5=INPUT,TAPE6=OUTPUT,	0401	1
	1 TAPE4,TAPE7)	0401	2
C		0401	3
C	VERSIONIDEMON2.	0401	4
C		0401	5
C	PLANAR OR CRUCIFORM WING-BODY PROGRAM, SUPERSONIC FLOW	0401	6
C	SET UP GEOMETRY, COORDINATES, AERODYNAMIC INFLUENCE COEFFICIENT	0401	7
C	MATRIX, SOLVE FOR CONSTANT U-VELOCITY PANEL STRENGTHS.	0401	8
C		0401	9
	DIMENSION RNS(250),YR(20),YRT(20),THU(100),THV(100),THW(100),	0401	10
	1 VLT(20),HEAD(20),ZUT(20),ZDT(20)	0401	11
C		0401	12
C	LOGICAL ASYM,BODY,DELTA,TRUSYM,NOSYM,DELTAS,TAIL,ASYMT	0401	13
		0401	14
	COMMON FVN(1)	0401	15
	COMMON/ONE/CIRC(250),DELTP(250),FN(250),PNLC(250),SWPPL(250),	0401	16
	1 SWPPE(250),VNOR(250),XBAR(250),ZBAR(250),XCPT(250),YCPT(250),ZCPT(250)	0401	17
	2(250),XLF(250),XLH(250),XHF(250),XRB(250),YLC(250),YRC(250),ZLF(250)	0401	18
	30),ZRF(250),ZLB(250),ZRH(250),SNT(125),CST(125),SMT2(125),CST2(125)	0401	19
	4),IP(300),XFHIP(100),A,ALFA,ALFR,AR*ING,B2,R2V,BETA,BETAR,CONST,	0401	20
	5COSALF,COSRET,CN,DX,EX,FMACH,KCIR,SINALF,SINRET,SLOPE,TLRNC,TIPY,	0401	21
	6TOTLR,U,V,W,UCHK,VCHK,WCHK,WHIP,X,Y,Z,IV,IF,II,JV,MSWR,MSWL,MSWL,	0401	22
	7MSWD,NHIP,NCRX,NCW,NDRAG,NHP,NPR,NRP,N3P,NOCPT,NOLINP,NOUT,NPANELS,	0401	23
	NPRESS,NWHP,ASYM,BODY,DELTAS,NOSYM	0401	24
	COMMON/THREE/ANGLR,ANGLL,ANGLU,ANGLD,DELR,DELL,DELU,DELD,SREF,REFL	0401	25
	COMMON/SWEEPS/VSWLER(20),VSWTER(20),VSWLEL(20),VSWTEL(20),	0401	26
	1 VSWLEU(20),VSWTEU(20),VSWLED(20),VSWTEL(20),LVSWP,LEFT,FAC,NCWB,	0401	27
	2ARPHL(250),*IDTH(250)	0401	28
	COMMON/KVEL/HOU(150),HOU(150),HOW(150),XFLOP(150),YFLOP(150),	0401	29
	1 ZFLDP(150)	0401	30
	COMMON/SPSANG/SINALC,CUSALC,SINPHI,COSPHI	0401	31
	COMMON/VRTX/VVRTX(150),WVRTX(150),NVRTPL,NVRTX,VRTMAX	0401	32
	COMMON/WHTH/THI(125),X*LE	0401	33
	COMMON/THKDAT/NDAT,NCWT,NTPR,MSWT(4),NRPT,NMPT,N3PT,NTHP,ASYMT,	0401	34
	1 NVERT,S*LET(20,4),S*LET(20,4),YTH(20,4),THETA(400)	0401	35
	COMMON/THVELU/THETA,TLRNC,THISO	0401	36
	COMMON/ICVEL/UTCHK,VCHK,*TCHK,IIT,IFT,MJ	0401	37
	COMMON/TSPANS/SPANR,SPANL,SPANU,SPAND,SWPLER,SWPLEL,SWPLEU,	0401	38
	1 SWPLED,SWPTER,SWPTL,SWPTU,SWPTED,PRND	0401	39
	COMMON/VPTHVL/VVEL(500),VVEL(500),JCPT,NCPNUT,NVLIN	0401	40
	COMMON/VNORSPC/GAMMA(10),VVRTX(10),ZVRTX(10),RLNC	0401	41
	COMMON/FINLE/XLE(80),CGLOC(80),GAMLE(80),FKLE,NEDGV,MLEVR,MLEVL,	0401	42
	1 MLEVU,MLEVH	0401	43
	COMMON/FINSE/XSF(80),CGSELC(80),GAMSE(80),FKSE,NSIDGE,NSEV	0401	44
	COMMON /ELLIPS/ RA,RB,ERATIO	0401	45
	COMMON /INTROT/ PHIOIN,THETIT,YAOD,ZBOD,PHIER,PHIFU	0401	46
	COMMON/DAFM/XN,ZM,CZOA,CYOA,CHUA,CLNOA,CLLOA	0401	47
C		0401	48
C		0401	49
	DATA PI/3.141592653590/	0401	50
	DATA QUIT/44ZZZZ/	0401	51
C		0401	52
	NAMELIST /INPUT/CRP,SWLEP,SNTPE,NCW,MSWR,MSWL,ALFAC,PHI,H2,FMACH,	0401	53
	1 LVSWP, FAC, *FVNPR, TOLFAC,MSWD,MSWD,SWLEV,S*TEV,	0401	54
	1 CRPV,R2V,NCRX,RB,RA,ERATIO,NBDCR,DELR,DELL,DELU,DELD,SREF,REFL,	0401	55
	1 PHIOIN,THETIT,X*LE,	0401	56
	1 NOLINP,NOUT,NPR,NDRAG,NVRTX,NPRESS,VRTMAX ,NCWB,NAGAIN,BIL,	0401	57
	1 ITAIL,NVRTPL, NBDYPR,NTPW,	0401	58
	2NDAT,NCWT,NCPNUT,NVLIN,XSTART,JCPT,FKLE,FKSE,XM,ZM	0401	59
C		0401	60
C		0401	61
	1 FORMAT (20A4)	0401	62
	2 FORMAT (1H1,20A4)	0401	63

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733	FORMAT (1X,I2,2X,F10.5,2(5X,F10.5))	DM01	127
734	FORMAT (1H1,4X,14H*ING 1 SURFACE //)	DM01	128
735	FORMAT (1H1,4X,14H*ING 2 SURFACE //)	DM01	129
736	FORMAT (1H1,4X,14H*ING 3 SURFACE //)	DM01	130
737	FORMAT (1H1,4X,14H*ING 4 SURFACE //)	DM01	131
744	FORMAT (1H1,4X,12H*ING SURFACE//)	DM01	132
745	FORMAT (15,3G12.5)	DM01	133
746	FORMAT (15,5E12.5)	DM01	134
747	FORMAT (1H1,10X,83HPPOINT COORDINATES AND PERTURBATION VELOCITIES	DM01	135
	1 CALCULATED BY PROGRAM VPATH OR VPATHL,///,	DM01	136
	2 5X,2HIC,5X,3H*CP,9X,3HYCP,9X,3HZCP,4X,8HVVEL(IC),6X,8H*VEL(IC)//	DM01	137
		DM01	138
		DM01	139
		DM01	140
999	CONTINUE	DM01	141
		DM01	142
	DEFAULT VALUES FOR NAMELIST INPUT	DM01	143
		DM01	144
	ASYME.FALSE.	DM01	145
	BIL=0.0	DM01	146
	BODY=.FALSE.	DM01	147
	BZV=0.0	DM01	148
	CRPV=0.0	DM01	149
	DELR=0.0	DM01	150
	DELL=0.0	DM01	151
	DELU=0.0	DM01	152
	DELD=0.0	DM01	153
	FRATIO=1.	DM01	154
	FAC=0.95	DM01	155
	FKLE=0.5	DM01	156
	FKSE=0.5	DM01	157
	ITAIL=0	DM01	158
	JCPT=0	DM01	159
	LVSKP=0	DM01	160
	MSWL=0	DM01	161
	MSWD=0	DM01	162
	MSWU=0	DM01	163
	NAGAIN=0	DM01	164
	NHDCR=0	DM01	165
	NHGYPR=0	DM01	166
	NCPHUT=0	DM01	167
	NCRX=0	DM01	168
	NCHW=0	DM01	169
	NCHT=0	DM01	170
	NCHAG=0	DM01	171
	NFVMPH=0	DM01	172
	NHILIN=0	DM01	173
	NHUT=0	DM01	174
	NPR=0	DM01	175
	NPRESS=0	DM01	176
	NIDATE=0	DM01	177
	NTPR=0	DM01	178
	NVLIN=0	DM01	179
	NVHTPL=0	DM01	180
	NVHTX=0	DM01	181
	PHI=0.0	DM01	182
	RA=0.	DM01	183
	RB=0.0	DM01	184
	REFL=1.0	DM01	185
	SREF=1.0	DM01	186
	SKLEP=0.0	DM01	187
	SKLEV=0.0	DM01	188
	SKTEP=0.0	DM01	189

S*TFV=0.0	DM01 190
TOLFAC=1.0	DM01 191
VRTMAX=0.35	DM01 192
X=0.0	DM01 193
XSTART=0.0	DM01 194
X*LE=0.0	DM01 195
Z=0.0	DM01 196
C	DM01 197
C	DM01 198
C	DM01 199
C	DM01 200
PHIFR=0.0	DM01 201
PHIFL=0.0	DM01 202
PHIFUR=0.0	DM01 203
PHIFD=0.0	DM01 204
THETR=0.0	DM01 205
THETL=0.0	DM01 206
THETU=0.0	DM01 207
THETD=0.0	DM01 208
PHIDT=0.0	DM01 209
THETIT=0.0	DM01 210
C	DM01 211
C	DM01 212
C	DM01 213
C*****	DM01 214
C SET CORE REQUIREMENT BASED ON FVN(1)	DM01 215
C LFL=0	DM01 216
C CALL NEQFL(LFL)	DM01 217
C	DM01 218
C*****	DM01 219
C	DM01 220
C WING GEOMETRY SPECIFIED IN PLANFORM,	DM01 221
C GEOMETRICALLY SYMMETRIC WINGS ONLY	DM01 222
C	DM01 223
C	DM01 224
C READ HEADER CARD	DM01 225
C	DM01 226
C READ(5,1) HEAD	DM01 227
C IF(HEAD(1).EQ.QUIT) STOP	DM01 228
C	DM01 229
C READ NAMELIST INPUT	DM01 230
C	DM01 231
C READ (5,INPUT)	DM01 232
C	DM01 233
C	DM01 234
C	DM01 235
C	DM01 236
C	DM01 237
C	DM01 238
C	DM01 239
C	DM01 240
C	DM01 241
C	DM01 242
C	DM01 243
C	DM01 244
C	DM01 245
C	DM01 246
C	DM01 247
C	DM01 248
C	DM01 249
C	DM01 250
C	DM01 251
C	DM01 252

C		DM01	253
C	FIN ANGLE PROPERTIES	DM01	254
C		DM01	255
C	SLPHLE=TAN(S*LEP*DTOR)	DM01	256
C	SLPHE=TAN(S*LEP*DTOR)	DM01	257
C	SLPVL=TAN(S*LEV*DTOR)	DM01	258
C	SLPVE=TAN(S*LEV*DTOR)	DM01	259
C		DM01	260
C	CHECK FOR INTERDIGITATED TAIL DIMEORAL ANGLES	DM01	261
C		DM01	262
C	NOTE: IF INTERDIGITATED FINS ARE UNDER CONSIDERATION, THE FOLLOWING	DM01	263
C	CORRELATION HOLDS.	DM01	264
C		DM01	265
C	RIGHT UPPER FIN.....RIGHT OR 1	DM01	266
C	LEFT LOWER FIN.....LEFT OR 2	DM01	267
C	RIGHT LOWER FIN.....UPPER OR 3	DM01	268
C	LEFT UPPER FIN.....LOWER OR DOWN OR 4	DM01	269
C	THIS DESIGNATION ESTABLISHES CORRESPONDENCE BETWEEN CRUCIFORM AND	DM01	270
C	INTERDIGITATED FINS.	DM01	271
C	NOTE: THE DIMEORAL ANGLE DEFINED AS THE CANT ANGLE WERE.	DM01	272
C		DM01	273
C	IF (THETIT.LE.0.0 .OR. THETIT.GE.90.) GO TO 22	DM01	274
C		DM01	275
C	PHIR = UPPER RIGHT CANT ANGLE, PHIL = LOWER LEFT CANT ANGLE	DM01	276
C	PHIRU = LOWER RIGHT CANT ANGLE, PHIFU = UPPER LEFT CANT ANGLE	DM01	277
C		DM01	278
C	PHIR = PHIRH	DM01	279
C	PHIL = PHILH	DM01	280
C	PHIRU = PHIRH	DM01	281
C	PHIFU = PHIFH	DM01	282
C		DM01	283
C		DM01	284
C	THETR, THETO DEFINE LOCATIONS OF RHS FINS ON BODY CIRCUMFERENCE	DM01	285
C	MEASURED POS. FROM +Y*AXIS COUNTERCLOCKWISE.	DM01	286
C	THETL, THETO DEFINE LOCATIONS OF LHS FINS ON BODY CIRCUMFERENCE	DM01	287
C	MEASURED POS. FROM -Y*AXIS COUNTERCLOCKWISE.	DM01	288
C		DM01	289
C	THETR = THETIT	DM01	290
C	THETL = THETIT	DM01	291
C	THETR = THETIT	DM01	292
C	THETO = THETIT	DM01	293
C	22 CONTINUE	DM01	294
C		DM01	295
C	ELLIPSE PROPERTIES	DM01	296
C	RR...HORIZONTAL SEMI-AXIS	DM01	297
C	RA...VERTICAL SEMI-AXIS	DM01	298
C		DM01	299
C	IF (RA.EQ.0. .AND .RH.EQ.0.) GO TO 23.	DM01	300
C	IF (RA.EQ.0.) RA=RH/EPATIO	DM01	301
C	IF (RH.EQ.0.) RH=RA*EPATIO	DM01	302
C	EPATIO=RH/RA	DM01	303
C	23 CONTINUE	DM01	304
C	RCIR=SQRT(RA*RH)	DM01	305
C	RHOD=RH	DM01	306
C		DM01	307
C		DM01	308
C	LOGICAL VARIABLE ASYM GOVERNS LAYOUT OF SKEWED PANELS WHICH	DM01	309
C	ONLY CAN BE DONE WHEN THERE IS NO BODY PRESENT.	DM01	310
C	PRESENTLY, PLANAR DELTA WINGS ONLY.	DM01	311
C		DM01	312
C	LOGICAL VARIABLE TRUSYM MAKES USE OF GEOMETRIC AND LOADING	DM01	313
C	SYMMETRY PROPERTIES	DM01	314
C		DM01	315

	ASVMS=(BETAY,NE,0,0),AND,(NRDCR,EQ,0)	DM01 316
	BODY=NRDCR,NE,0	DM01 317
	DELTA=DELR,NE,0,0,OR,DELL,NE,0,0,OR,DELU,NE,0,0,OR,DELD,NE,0,0	DM01 318
	DELTAS=DELR,NE,DELL,OR,DELU,NE,0,0,OR,DELD,NE,0,0	DM01 319
	TRUSYM=BETAY,EQ,0,0,AND,,NOT,DELTAS	DM01 320
	NOSYM=,NOT,TRUSYM	DM01 321
	TAIL=ITAIL,NE,0	DM01 322
C		DM01 323
	TIPY=H2	DM01 324
	NRP=NC**MSWR	DM01 325
	NRP1=NRP+1	DM01 326
	NHP=NC** (MSWR+MSWL)	DM01 327
	NHP1=NHP+1	DM01 328
	N3P=NC** (MSWL+MSWR+MSWU)	DM01 329
	N3P1=N3P+1	DM01 330
	NPANLS=NC** (MSWR+MSWL+MSWU+MSW0)	DM01 331
	IF (TRUSYM) NPANLS=NRP	DM01 332
	IF (TRUSYM,AND,THETIT,GT,0,0) VPANLS=NC** (MSWR+MSWU)	DM01 333
	NPANLP=NPANLS+1	DM01 334
	NRIP=VCNH*NRDCR	DM01 335
	IF (TRUSYM,AND,BODY) NRIP=NRIP/2	DM01 336
	NWRP=NPANLS+NRIP	DM01 337
	IF (NWRP,GT,8) NRP=0	DM01 338
C		DM01 339
	WRITE (6,2) HEAD	DM01 340
C		DM01 341
C		DM01 342
C	ANGLES ANGLR,ANGLL,ANGLU,ANGLO GOOD ONLY FOR CRUCIFORM FINS OR	DM01 343
C	MONO-PLANE WING.	DM01 344
C		DM01 345
	RDELR=DELR*DTOR	DM01 346
	ANGLR=RDELR + ALFR	DM01 347
	RDELL=DELL*DTOR	DM01 348
	ANGLL=ALFR+RDELL	DM01 349
	RDELU=DELU*DTOR	DM01 350
	ANGLU=BETAW+RDELU	DM01 351
	RDELD=DELD*DTOR	DM01 352
	ANGLO=BETAW+RDELD	DM01 353
	BETA=SQRT(ABS(FMACH*FMACH-1.))	DM01 354
	TLRNC=(H2+15,E-5)**2*TOIFAC	DM01 355
	TOTLR=2.0*TLRNC	DM01 356
	CONST=4.0*PI	DM01 357
	TBETA=BETA	DM01 358
	TBTSQ=BETA*BETA	DM01 359
	TTLRNC=TLRNC	DM01 360
	NVERTENCRX	DM01 361
	ASYMT=ASYM	DM01 362
C		DM01 363
C		DM01 364
	WRITE(6,INPUT)	DM01 365
	IF (NAGAIN,GT,1) GO TO 53	DM01 366
C		DM01 367
C		DM01 368
C	*****	DM01 369
C	UP TO STATEMENT 69 IS FOR WING ALONE CASE	DM01 370
C	*****	DM01 371
C	NOTE: IF NDRAG1, USE A MAXIMUM OF 150 PANELS	DM01 372
C		DM01 373
	IF(ASYM,OR,BODY,OR,NCRX,NE,0) GO TO 69	DM01 374
	MSWRP=MSWR+1	DM01 375
	IF(LVSWP,EQ,0) GO TO 25	DM01 376
C		DM01 377
C	FOR THIS CASE VK(KJ) MEASURED FROM WING CENTERLINE.	DM01 378

C	READ(5,713) (YR(KJ),VS=LER(KJ),VS=ATER(KJ),KJ=1,MS=RP)	0401 379
	S=PLER=VS=LER(MS=RP)	0401 380
	S=PTER=VS=ATER(MS=RP)	0401 381
	GO TO 26	0401 382
C		0401 383
C	LAY OUT THE SPANWISE LOCATION OF PANEL NOS. YR(I) IN THE PLANFORM	0401 384
C	PLANE	0401 385
C	IF THEY WERE NOT READ IN ALREADY	0401 386
C		0401 387
	25 Y=1)=0.0	0401 388
	YR(MS=RP)=H2	0401 389
	DY=H2/MS=RP	0401 390
	DO 110 I=2,MS=RP	0401 391
	AI=I-1	0401 392
	110 YR(I)=YR(1)+DY*AI	0401 393
	S=PLER=S=LEP	0401 394
	S=PTER=S=ATEP	0401 395
	26 SPAN=H2	0401 396
	CRPT=CRP	0401 397
	GO TO 68	0401 398
C		0401 399
C	IF WITH SIDESET AND WITHOUT BODY.	0401 400
C	WING GEOMETRY LAID OUT RELATIVE TO LINE FORMED BY	0401 401
C	INTERSECTION OF STREAMWISE PLANE THROUGH WING ROOT CHORD LE AND	0401 402
C	WING PLANFORM PLANE (A STREAMWISE LINE)	0401 403
C	THIS PROGRAM OPTION CAN ONLY BE USED FOR DELTA WING	0401 404
C	WITHOUT BODY.	0401 405
C		0401 406
	69 CONTINUE	0401 407
	MS=RP=MS=RP+1	0401 408
	S=LEP=S=LEP+1	0401 409
	MS=UP=MS=UP+1	0401 410
	MS=DP=MS=DP+1	0401 411
	IF (BODY) GO TO 74	0401 412
	IF (.NOT.ASYN) GO TO 74	0401 413
	IF (CVS=0,NE,0) GO TO 60	0401 414
	S=PLER=S=LEP+RETAY	0401 415
	S=PTER=S=ATEP+RETAY	0401 416
	S=PLEL=S=LEP+RETAY	0401 417
	S=PTLEL=S=ATEP+RETAY	0401 418
	CTP=CRP+H2*(S=LEP+LE=3LEP+TE)	0401 419
	CRPT=CRP*(COSHET+SINHET*TAN(S=PTLEL*DTOR))	0401 420
	SPANL=(H2/COS(S=LEP*DTOR))*COS(S=PLEL*DTOR)	0401 421
	SPANR=(H2/COS(S=LEP*DTOR))*COS(S=PLER*DTOR)+CTP*SINHET	0401 422
	GO TO 76	0401 423
C		0401 424
C	SET UP GEOMETRICALLY SYMMETRIC LAY-OUT.	0401 425
C		0401 426
	73 S=PLER=S=LEP	0401 427
	S=PTER=S=ATEP	0401 428
	S=PLEL=S=LEP	0401 429
	S=PTLEL=S=ATEP	0401 430
	CRPT=CRP	0401 431
	SPAN=H2	0401 432
	SPANL=H2	0401 433
	74 CONTINUE	0401 434
	IF (BODY,0,0) GO TO 77	0401 435
C		0401 436
C	CASE FOR VERTICAL WING PANELS	0401 437
C		0401 438
C	IF (BODY) GO TO 75	0401 439
		0401 440
		0401 441



IF (.NOT.ASYM) GO TO 75	
S*PLEU=S*LEV+ALFA	DM01 442
S*PTEU=S*TEV+ALFA	DM01 443
S*PLED=S*LEV+ALFA	DM01 444
S*PTED=S*TEV+ALFA	DM01 445
CTPV=CRPV+82V*(SLPVLE+SLPVE)	DM01 446
CRPTV=CRPV*(COSALF+SINALF*TAN(S*PTEU*DTOR))	DM01 447
SPANU=(82V/COS(S*LEV*DTOR))*COS(S*PLEU*DTOR)	DM01 448
SPAND=(82V/COS(S*LEV*DTOR))*COS(S*PLED*DTOR)+CTPV*SINALF	DM01 449
GO TO 77	DM01 450
75 S*PLEU=S*LEV	DM01 451
S*PTEU=S*TEV	DM01 452
S*PLED=S*LEV	DM01 453
S*PTED=S*TEV	DM01 454
CRPTV=CRPV	DM01 455
SPANU=82V	DM01 456
SPAND=82V	DM01 457
77 CONTINUE	DM01 458
	DM01 459
	DM01 460
SLPWLR= TAN(S*PLER*DTOR)	DM01 461
SLPWTR= TAN(S*PTER*DTOR)	DM01 462
SLPWLL= TAN(S*PLEL*DTOR)	DM01 463
SLPWTL= TAN(S*PTEL*DTOR)	DM01 464
IF (NCRX.EQ.0) GO TO 64	DM01 465
SLPWLU= TAN(S*PLEU*DTOR)	DM01 466
SLPWLD= TAN(S*PLED*DTOR)	DM01 467
SLPWLU= TAN(S*PLEU*DTOR)	DM01 468
SLPWLD= TAN(S*PLED*DTOR)	DM01 469
64 IF (LVSAP.EQ.0) GO TO 65	DM01 470
	DM01 471
READ IN NON UNIFORM DISTANCES TO PANEL OUTBOARD EDGES.	DM01 472
IF WITH A BODY, MEASURE FROM FIN ROOT CHORD.	DM01 473
	DM01 474
60 READ (5,713) (VRT(KJ),VSWLER(KJ),VSWTER(KJ),KJ=1,MSWRP)	DM01 475
S*PLER=VSWLER(MSWRP)	DM01 476
S*PTER=VSWTER(MSWRP)	DM01 477
S*PLEU=S*PLER	DM01 478
S*PTEU=S*PTER	DM01 479
SPANR=VRT(MSWRP)-VRT(1)	DM01 480
SPANL=SPANR	DM01 481
SPANU=SPANR	DM01 482
IF (TRUSYM.AND. THETIT.LE.0.) GO TO 68	DM01 483
IF (TRUSYM) GO TO 61	DM01 484
READ (5,713) (VLT(KJ),VSWLEL(KJ),VSWTEL(KJ),KJ=1,MSWLP)	DM01 485
S*PLEL=VSWLEL(MSWLP)	DM01 486
S*PTEL=VSWTEL(MSWLP)	DM01 487
SPANL=(VLT(MSWLP)-VLT(1))	DM01 488
IF (NCRX.EQ.0) GO TO 68	DM01 489
	DM01 490
	DM01 491
IF TRUSYM IS TRUE AND INTERDIGITATED TAIL IS TREATED.	DM01 492
DATA IS EXPECTED FOR THE RIGHT UPPER AND LOWER FINS	DM01 493
	DM01 494
61 READ(5,713) (ZUT(KJ),VSWLEU(KJ),VSWTEU(KJ),KJ=1,MSWUP)	DM01 495
S*PLEU=VSWLEU(MSWUP)	DM01 496
S*PTEU=VSWTEU(MSWUP)	DM01 497
SPANU=ZUT(MSWUP)-ZUT(1)	DM01 498
IF (TRUSYM) GO TO 68	DM01 499
READ(5,713) (ZDT(KJ),VSWLED(KJ),VSWTED(KJ),KJ=1,MSWDP)	DM01 500
S*PLED=VSWLED(MSWDP)	DM01 501
S*PTED=VSWTED(MSWDP)	DM01 502
SPAND=(ZDT(MSWDP)-ZDT(1))	DM01 503
GO TO 68	DM01 504
65 CONTINUE	

C		DM01 505
C	EQUAL SPANWISE WIDTHS, CONSTANT SWEEPS	DM01 506
C	PANELS IN HORIZONTAL WING SURFACES	DM01 507
C		DM01 508
	YRT(1)=0.0	DM01 509
	YRT(MSWRP)=SPANR+YRT(1)	DM01 510
	OYR=SPANR/MSWR	DM01 511
	DO 51 I=2,MSWR	DM01 512
	AI=I-1	DM01 513
51	YRT(I)=OYR*AI+YRT(1)	DM01 514
	IF (TRUSYM .AND. THETIT.EQ.0.0) GO TO 68	DM01 515
C		DM01 516
	IF (TRUSYM) GO TO 57	DM01 517
	YLT(1)=0.0	DM01 518
	YLT(MSWLP)=SPANL+YLT(1)	DM01 519
	OYL=SPANL/MSWL	DM01 520
	DO 52 I=2,MSWL	DM01 521
	AI=I-1	DM01 522
52	YLT(I)=OYL*AI+YLT(1)	DM01 523
	IF (NCRX.EQ.0) GO TO 68	DM01 524
C		DM01 525
C	PANELS IN VERTICAL PLANE	DM01 526
C		DM01 527
57	ZUT(1)=0.0	DM01 528
	ZUT(MSWUP)=SPANU+ZUT(1)	DM01 529
	OZU=SPANU/MSWU	DM01 530
	DO 54 I=2,MSWU	DM01 531
	AI=I-1	DM01 532
54	ZUT(I)=OZU*AI+ZUT(1)	DM01 533
C		DM01 534
	IF (TRUSYM) GO TO 68	DM01 535
	ZDT(1)=0.0	DM01 536
	ZDT(MSWDP)=SPAND+ZDT(1)	DM01 537
	OZD=SPAND/MSWD	DM01 538
	DO 55 I=2,MSWD	DM01 539
	AI=I-1	DM01 540
55	ZDT(I)=OZD*AI+ZDT(1)	DM01 541
68	CONTINUE	DM01 542
C		DM01 543
	IF (LVSWP.EQ.0) GO TO 79	DM01 544
	IF (ASYM.OR.BODY.OR.NCRX.NE.0) GO TO 28	DM01 545
	WRITE (6,744)	DM01 546
	WRITE (6,732)	DM01 547
	DO 29 K=1,MSWRP	DM01 548
29	WRITE (6,733) K,YR(K),VS*LER(K),VS*TER(K)	DM01 549
	GO TO 79	DM01 550
2A	WRITE (6,734)	DM01 551
	WRITE (6,732)	DM01 552
	DO 80 K=1,MSWRP	DM01 553
80	WRITE (6,733) K,YRT(K),VS*LER(K),VS*TER(K)	DM01 554
	IF (TRUSYM .AND. THETIT.LE.0.) GO TO 79	DM01 555
	IF (TRUSYM) GO TO 84	DM01 556
	WRITE (6,735)	DM01 557
	DO 81 K=1,MSWLP	DM01 558
81	WRITE (6,733) K,YLT(K),VS*LER(K),VS*TER(K)	DM01 559
	IF (NCRX.EQ.0) GO TO 79	DM01 560
84	WRITE (6,736)	DM01 561
	DO 82 K=1,MSWUP	DM01 562
82	WRITE (6,733) K,ZUT(K),VS*LER(K),VS*TER(K)	DM01 563
	IF (TRUSYM) GO TO 79	DM01 564
	WRITE (6,737)	DM01 565
	DO 83 K=1,MSWDP	DM01 566
83	WRITE (6,733) K,ZDT(K),VS*LER(K),VS*TER(K)	DM01 567

70 CONTINUE	DM01 568
C	DM01 569
C	DM01 570
C LAY-OUT ELEMENTAL PANELS ON WING ALONE.	DM01 571
C	DM01 572
IF (ASYM,OR,BODY,OR,NCRX,NE,0) GO TO 50	DM01 573
CALL LAYOUT(SLPWLE,SLPWTE,YR,MSARP,CRP,1,CTP,PHIFR,THETR)	DM01 574
IF (NOUT,EO,1) WRITE (6,715) ASYM,TLRNC,LEFT,BODY,DELTA,TRUSYM,	DM01 575
NOSYM	DM01 576
GO TO 53	DM01 577
C	DM01 578
C	DM01 579
C LAY-OUT ELEMENTAL PANELS ON THE FINS.	DM01 580
C	DM01 581
C NOTE: DISTANCES YRT,YLT,ZUT,ZDT ARE MEASURED FROM THE FIN ROOT	DM01 582
C CHORDS IF BODY IS PRESENT	DM01 583
C	DM01 584
C	DM01 585
50 CALL LAYOUT(SLPWLP,SLPWTR,YRT,MSARP,CRPT,1,CTP,PHIFR,THETR)	DM01 586
IF (NOUT,EO,1) WRITE (6,715) ASYM,TLRNC,LEFT,BODY,DELTA,TRUSYM,	DM01 587
INOSYM	DM01 588
IF (NCRX,NE,0) CTPV=CTP	DM01 589
IF (TRUSYM,AND,THETIT,LE,0,0) GO TO 62	DM01 590
C	DM01 591
IF (TRUSYM) GO TO 63	DM01 592
CALL LAYOUT(SLPWTL,SLPWTL,YLT,MSWLP,CRPT,2,CTPL,PHIFL,THETL)	DM01 593
IF (NOUT,EO,1) WRITE (6,715) ASYM,TLRNC,LEFT,BODY,DELTA,TRUSYM,	DM01 594
INOSYM	DM01 595
IF (NCRX,EO,0) GO TO 62	DM01 596
C	DM01 597
63 CALL LAYOUT(SLPWLU,SLPWTH,ZUT,MSWUP,CRPTV,3,CTPV,PHIFU,THETU)	DM01 598
IF (NOUT,EO,1) WRITE (6,715) ASYM,TLRNC,LEFT,BODY,DELTA,TRUSYM,	DM01 599
INOSYM	DM01 600
C	DM01 601
IF (TRUSYM) GO TO 62	DM01 602
CALL LAYOUT(SLPWLD,SLPWTD,ZDT,MSWUP,CRPTV,4,CTPVD,PHIFD,THETD)	DM01 603
IF (NOUT,EO,1) WRITE (6,715) ASYM,TLRNC,LEFT,BODY,DELTA,TRUSYM,	DM01 604
INOSYM	DM01 605
C	DM01 606
C LAY-OUT BODY INTERFERENCE PANELS	DM01 607
C	DM01 608
62 IF (NBHCR,EO,0) GO TO 53	DM01 609
CALL LAYOUT(SLPWLE,SLPWTE,0,0,NBHCR,HIL,5,0,0,0,0)	DM01 610
IF (NOUT,EO,1) WRITE (6,715) ASYM,TLRNC,LEFT,BODY,DELTA,TRUSYM,	DM01 611
INOSYM	DM01 612
53 CONTINUE	DM01 613
C	DM01 614
C	DM01 615
WRITE(6,701) CTP,CRP,H2	DM01 616
IF (LVSWP,EO,0) WRITE(6,719) SWLEP,SWTEP	DM01 617
WRITE (6,702) FMACH,ALFAC,PHI,ALFA,RETA	DM01 618
IF (.NOT,ASYM) GO TO 56	DM01 619
WRITE(6,722) SPANP,SPANL	DM01 620
IF (NCRX,NE,0) WRITE(6,727) SPAND,SPAND	DM01 621
56 CONTINUE	DM01 622
WRITE(6,723) CRPT	DM01 623
IF (NCRX,NE,0) WRITE(6,721) CRPTV	DM01 624
IF (NOUT,NE,1) GO TO 7813	DM01 625
WRITE(6,703)	DM01 626
WRITE(6,7030)	DM01 627
WRITE(6,708)	DM01 628
WRITE(6,706) (J,XLF(J),YLC(J),ZLF(J),XLR(J),YLC(J),ZLR(J),XRF(J),	DM01 629
1 YRC(J),ZRF(J),XPH(J),YPC(J),ZPH(J),J=1,NRP)	DM01 630

	IF (TRUSYM .AND. THETIT.LE.0.) GO TO 71	DM01 631
C	IF (TRUSYM) GO TO 73	DM01 632
	WRITE(6,709)	DM01 633
	WRITE(6,706) (J,XLF(J),YLC(J),ZLF(J),XLB(J),YLC(J),ZLB(J),XRF(J),	DM01 634
	1 YRC(J),ZRF(J),XRB(J),YRC(J),ZRB(J),J=NRP1,NRP)	DM01 635
	IF(NCRX.EQ.0) GO TO 71	DM01 636
		DM01 637
C	73 WRITE(6,710)	DM01 638
	WRITE(6,706) (J,XLF(J),YLC(J),ZLF(J),XLB(J),YLC(J),ZLB(J),XRF(J),	DM01 639
	1 YRC(J),ZRF(J),XRB(J),YRC(J),ZRB(J),J=NRP1,NRP)	DM01 640
	IF (TRUSYM) GO TO 71	DM01 641
		DM01 642
C	WRITE(6,711)	DM01 643
	WRITE(6,706) (J,XLF(J),YLC(J),ZLF(J),XLB(J),YLC(J),ZLB(J),XRF(J),	DM01 644
	1 YRC(J),ZRF(J),XRB(J),YRC(J),ZRB(J),J=N3P1,NPANLS)	DM01 645
		DM01 646
C	71 IF(NHDCR.EQ.0) GO TO 72	DM01 647
	WRITE(6,726)	DM01 648
	WRITE(6,7030)	DM01 649
	WRITE (6,706) (J,XLF(J),YLC(J),ZLF(J),XLB(J),YLC(J),ZLB(J),XRF(J),	DM01 650
	1 YRC(J),ZRF(J),XRB(J),YRC(J),ZRB(J),J=NPANLP,NWRP)	DM01 651
	WRITE (6,717)	DM01 652
	WRITE (6,718) (J,SWPPL(J),SWPPT(J),J=1,NWRP)	DM01 653
	GO TO 7813	DM01 654
	72 WRITE(6,717)	DM01 655
	WRITE(6,718) (J,SWPPL(J),SWPPT(J),J=1,NPANLS)	DM01 656
	7813 CONTINUE	DM01 657
		DM01 658
C		DM01 659
C		DM01 660
C	INPUT THICKNESS DATA, PRINT INPUT VALUES, AND LAY	DM01 661
C	OUT SOURCE PANELS ON FINS.	DM01 662
C	SUBROUTINE THKIN READS IN STREAMWISE THICKNESS SLOPES.	DM01 663
C		DM01 664
	IF(NTDAT.EQ.0) GO TO 88	DM01 665
	CALL THKIN	DM01 666
	CALL THKOUT	DM01 667
	CALL THKLYT(CRPT,0)	DM01 668
	IF(ASYM) CALL THKLYT(CRPT,1)	DM01 669
C		DM01 670
	IF(NCRX.EQ.0) GO TO 88	DM01 671
	CALL THKLYT(CRPTV,2)	DM01 672
	IF(ASYM) CALL THKLYT(CRPTV,3)	DM01 673
	88 CONTINUE	DM01 674
		DM01 675
C		DM01 676
C	INITIALIZE BODY INDUCED VELOCITIES AND VORTEX INDUCED VELOCITIES	DM01 677
C		DM01 678
	DO 10 KM=1,150	DM01 679
	VVRTX(KM)=0.0	DM01 680
	AVRTX(KM)=0.0	DM01 681
	HOU(KM)=0.0	DM01 682
	HOU(KM)=0.0	DM01 683
	10 HOU(KM)=0.0	DM01 684
C		DM01 685
	DO 11 IC=1,500	DM01 686
	VVEL(IC)=0.0	DM01 687
	11 VVEL(IC)=0.0	DM01 688
C		DM01 689
C		DM01 690
C	WHEN NCPOUT NOT ZERO,	DM01 691
C	PUT WING OR FIN CONTROL POINTS AND BODY INTERFERENCE PANEL	DM01 692
C	CONTROL POINTS IN DATA SET ON TAPE 4.	DM01 693

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C		*DM01 821
C	SPECIAL PURPOSE CORE MEMORY ECONOMY SECTION FOR RCS 6600	*DM01 822
C	SET CORE REQUIREMENT BASED ON LFL PLUS FVN(NWHP,NWHP)	*DM01 823
C	NOTE: ALREADY SET FVN(1).	DM01 824
C		*DM01 825
C	MFLTOT=LFL+NWHP*NWHP-1	DM01 826
C	CALL REQFL(MFLTOT)	DM01 827
C		*DM01 828
C	*****	*DM01 829
C		DM01 830
C	SET UP INFLUENCE COEFFICIENT MATRIX	DM01 831
C	IT IS THE LHS OF THE FLOW TANGENCY CONDITION.	DM01 832
C	NOTE: THE R.C. STATES THAT VELOCITY NORMAL TO THE PANELS MUST	DM01 833
C	BE ZERO.	DM01 834
C	THEREFORE ALL VELOCITIES MUST BE TRANSFORMED INTO INDIVIDUAL	DM01 835
C	FLAP COORDINATE SYSTEM.	DM01 836
C		DM01 837
C		DM01 838
C	CALCULATE THE INFLUENCE OF EACH PANEL ON EACH CONTROL POINT	DM01 839
C	II AND IF ARE THE LIMITS FOR SUMMATION OF THE INFLUENCE FUNCTION	DM01 840
C	IN SUBROUTINE VELNOR	DM01 841
C	IF II = IF, THE INFLUENCE OF A SINGLE PANEL AT A POINT RESULTS	DM01 842
C	AS IN THE COMPUTATION OF THE ARRAY FVN. IF II=1 AND IF=NWHP,	DM01 843
C	THE INFLUENCES ARE SUMMED OVER ALL PANELS, AS IN THE COMPUTATION	DM01 844
C	RESULTANT VELOCITIES BELOW....	DM01 845
C		DM01 846
C	--- I IS THE INDEX OF THE INFLUENCING PANEL	DM01 847
C		DM01 848
C		DM01 849
C	JJ=0	DM01 850
C	MUOPT=0	DM01 851
C	DO 450 I=1,NWHP	DM01 852
C	II=I	DM01 853
C	IF=I	DM01 854
C		DM01 855
C	J IS THE INDEX OF THE INFLUENCED PANEL, I.E. ITS CONTROL POINT.	DM01 856
C		DM01 857
C	DO 425 J=1,NWHP	DM01 858
C	JB=J-NPANELS	DM01 859
C	CALL VELNOR(XCPT(J),YCPT(J),ZCPT(J))	DM01 860
C	JJ=JJ+1	DM01 861
C	IF(J.LE.NPANELS) GO TO 417	DM01 862
C		DM01 863
C	INFLUENCED PANEL IS ON THE BODY INTERFERENCE SHELL.	DM01 864
C		DM01 865
C	CALL ROTAB (VCHK,WCHK,VV,WW,JB)	DM01 866
C	GO TO 418	DM01 867
C		DM01 868
C	INFLUENCED PANEL IS ON A FIN.	DM01 869
C		DM01 870
C	417 IF (J.LE.NWHP) PHIF=PHIFR*DTOR	DM01 871
C	IF (J.GT.NWHP.AND.J.LE.NPANELS) PHIF=PHIFU*DTOR	DM01 872
C	CALL ROTAB(VCHK,WCHK,VV,WW,PHIF)	DM01 873
C	418 FVN(JJ)=WW	DM01 874
C	425 CONTINUE	DM01 875
C	450 CONTINUE	DM01 876
C		DM01 877
C	DEBUG DUMP OF THE FVN ARRAY	DM01 878
C		DM01 879
C	IF(NFVNPR.EQ.0) GO TO 618	DM01 880
C	WRITE (6,707)	DM01 881
C	CALL OUT(FVN,NWHP)	DM01 882
C	618 CONTINUE	DM01 883

CALL LINEQS(NWBP,FVN)	DM01 884
IF (NAGAIN,NE,1) GO TO 9000	DM01 885
JMAX=NWBP**2	DM01 886
REWIND 5	DM01 887
HUFFER OUT (3,1) (FVN(1),FVN(JMAX))	DM01 888
NAGAIN=NAGAIN+1	DM01 889
IF (UNIT(3)) 27,27,27	DM01 890
27 CONTINUE	DM01 891
GO TO 9000	DM01 892
C*****	DM01 893
C	DM01 894
C CASE FOR NAGAIN G.T. 1, SET REQUIRED FIELD LENGTH.	DM01 895
C	DM01 896
8889 JMAX=NWBP**2	DM01 897
MFLTOT=LFL+NWBP*NWBP-1	DM01 898
CALL REGFL(MFLTOT)	DM01 899
C	DM01 900
C*****	DM01 901
C REWIND 3	DM01 902
C HUFFER IN (3,1) (FVN(1),FVN(JMAX))	DM01 903
C IF (UNIT(3)) 30,30,30	DM01 904
30 CONTINUE	DM01 905
9000 CONTINUE	DM01 906
C	DM01 907
C SET UP SINGLE COLUMN MATRIX RHS FOR RIGHT HAND SIDE	DM01 908
C IT REPRESENTS THE EXTERNALLY INDUCED VELOCITIES AND ANGLE OF	DM01 909
C PITCH AND SIDESLIP EFFECTS AS WELL AS FIN THICKNESS.	DM01 910
C NOTES: NO THICKNESS EFFECTS ACCOUNTED FOR IF INTERDIGITATED FINS	DM01 911
C ARE CONSIDERED.	DM01 912
C	DM01 913
C	DM01 914
C IF (NVLIN,EQ,0,OR,ITAIL,EQ,1) GO TO 607	DM01 915
C REWIND 7	DM01 916
C WRITE (6,747)	DM01 917
607 CONTINUE	DM01 918
C	DM01 919
C CASE FOR WING OR FIN ALL AT SAME ANGLE AS BODY	DM01 920
C	DM01 921
C READ IN VELOCITIES INDUCED BY MOVING VORTICES (CALCULATED BY	DM01 922
C PROGRAM VPATH) AT ALL CONSTANT U-VELOCITY PANEL CONTROL POINTS.	DM01 923
C	DM01 924
C	DM01 925
C IF (DELTA) GO TO 627	DM01 926
C DO 620 I=1,NWBP	DM01 927
C IC=I	DM01 928
C IF (NVLIN,EQ,0,OR,ITAIL,EQ,1) GO TO 605	DM01 929
C READ (7,746) IC,XCP,YCP,ZCP,VVEL(IC),WVEL(IC)	DM01 930
C WRITE (6,705) IC,XCP,YCP,ZCP,VVEL(IC),WVEL(IC)	DM01 931
605 CONTINUE	DM01 932
C WEXT=SINALF*BDW(I)+WVRTX(I)+WVEL(IC)	DM01 933
C VEXT=-SINRET*BDV(I)+VVRTX(I)+VVEL(IC)	DM01 934
C IF (I,GT,NPANELS) GO TO 601	DM01 935
C IF (I,LE,NHP) GO TO 602	DM01 936
C IF (I,LE,NPANELS) GO TO 604	DM01 937
601 RHS(I)=0.0	DM01 938
GO TO 620	DM01 939
602 PHIF=PHIFR+UTDR	DM01 940
C CALL RNTWF(VEXT,WEXT,VV,WW,PHIF)	DM01 941
C RHS(I)=WW	DM01 942
GO TO 620	DM01 943
604 PHIF=PHIFR+DTDR	DM01 944
C CALL RNTWF(VEXT,WEXT,VV,WW,PHIF)	DM01 945
	DM01 946



	RHS(I)=WW		
620	CONTINUE		DM01 947
	GO TO 646		DM01 948
C			DM01 949
C	RIGHT HAND SIDE FOR WINGS OR FINS TILTED WITH RESPECT TO BODY		DM01 950
C			DM01 951
627	CONTINUE		DM01 952
	DO 645 K=1,NWBP		DM01 953
	IC=K		DM01 954
	IF (NWLIN.EQ.0.OR.ITAIL.EQ.1) GO TO 606		DM01 955
	READ (7,746) IC,XCP,YCP,ZCP,VVEL(IC),WVEL(IC)		DM01 956
	WRITE (6,705) IC,XCP,YCP,ZCP,VVEL(IC),WVEL(IC)		DM01 957
606	CONTINUE		DM01 958
	VEXT=-SINHET*HDV(K)+VVRTX(K)+VVVEL(IC)		DM01 959
	WEXT=STINALF*HDW(K)+WVRTX(K)+WVEL(IC)		DM01 960
	IF (K.GT.NPANLS) GO TO 603		DM01 961
	IF (K.LE.NRP) GO TO 641		DM01 962
	IF (K.LE.NHP) GO TO 642		DM01 963
	IF (K.LE.N3P) GO TO 643		DM01 964
	IF (K.LE.NPANLS) GO TO 644		DM01 965
603	RHS(K)=0.0		DM01 966
	GO TO 645		DM01 967
641	PHIF=PHIFR*DTOR		DM01 968
	CALL ROTXF(VEXT,WEXT,VV,WW,PHIF)		DM01 969
	RHS(K)=WW*SIN(RDELK)		DM01 970
	GO TO 645		DM01 971
642	PHIF=PHIFL*DTOR		DM01 972
	CALL ROTXF(VEXT,WEXT,VV,WW,PHIF)		DM01 973
	RHS(K)=WW*SIN(RDELL)		DM01 974
	GO TO 645		DM01 975
643	PHIF=PHIFU*DTOR		DM01 976
	CALL ROTXF(VEXT,WEXT,VV,WW,PHIF)		DM01 977
	RHS(K)=WW*SIN(RDELU)		DM01 978
	GO TO 645		DM01 979
644	PHIF=PHIFD*DTOR		DM01 980
	CALL ROTXF(VEXT,WEXT,VV,WW,PHIF)		DM01 981
	RHS(K)=WW*SIN(RDELD)		DM01 982
645	CONTINUE		DM01 983
646	CONTINUE		DM01 984
C			DM01 985
C	ADD IN PERTURBATION VELOCITY COMPONENTS INDUCED BY FIN		DM01 986
C	SOURCE PANELS AT THE BODY INTERFERENCE PANEL CONTROL POINTS.		DM01 987
C			DM01 988
	IF (NTOT.EQ.0.OR..NOT.BODY) GO TO 91		DM01 989
	IIT=1		DM01 990
	IFT=NTHP		DM01 991
	DO 90 K=NPANLP,NWBP		DM01 992
	MJ=K		DM01 993
	CALL THKVEL(XCPT(K),YCPT(K),ZCPT(K))		DM01 994
	KB=K-NPANLS		DM01 995
	THU(KB)=VTCHK		DM01 996
	THV(KB)=VTCHK		DM01 997
	THW(KB)=VTCHK		DM01 998
C			DM01 999
C	INFLUENCED PANEL IS A BIP. RESOLVE WING-FRAME		DM011000
C	VELOCITIES INTO BIP FRAME.		DM011001
C			DM011002
	CALL ROTAR(VTCHK,WTCHK,VT,WT,KB)		DM011003
	RHS(K)=RHS(K)-WT		DM011004
90	CONTINUE		DM011005
	GO TO 92		DM011006
91	DO 93 K=NPANLP,NWBP		DM011007
	KB=K-NPANLS		DM011008
	THU(KB)=0.0		DM011009
	THV(KB)=0.0		DM011010

93	TH*(KH)=0.0	DM011011
92	CONTINUE	DM011012
C		DM011013
	IF (NOUT.NE.0) WRITE (6,728)	DM011014
	IF (NOUT.EQ.0) GO TO 648	DM011015
	WRITE(6,729) (K,RHS(K),K=1,NWBP)	DM011016
648	CONTINUE	DM011017
	CALL SOLVE(RHS,FVN,NWRP)	DM011018
	IF (NOUT.NE.0) WRITE(6,731)	DM011019
	DO 630 I=1,NWBP	DM011020
	DEMONP=RHS(I)*CONST	DM011021
	DELTP(I)=DEMONP	DM011022
	IF (ABS(DELTP(I)).LT.1.0E-10) DELTP(I)=0.0	DM011023
	IF (NOUT.EQ.0) GO TO 630	DM011024
	WRITE(6,729) I,DELTP(I)	DM011025
630	CONTINUE	DM011026
C	*****	DM011027
C	REDUCE REQUIRED CORE ALLOCATION BACK TO LFL SIZE	DM011028
C		DM011029
	CALL REQFL(LFL)	DM011030
C		DM011031
C	*****	DM011032
C		DM011033
C	PRINT CONTROL POINT COORDINATES OF THE CONSTANT U-VELOCITY PANELS	DM011034
C	ON THE WING OR FIN SURFACES AND THE EXTERNALLY INDUCED	DM011035
C	VELOCITIES AT THE CONTROL POINTS.	DM011036
C		DM011037
C		DM011038
	WRITE(6,704) NCW,MSWR,MSWL,MSWU,MSWD	DM011039
	WRITE(6,705) (J,XCPT(J),YCPT(J),ZCPT(J),BDU(J),BDV(J),BDW(J),	DM011040
	1VVRTX(J),WVRTX(J),J=1,NPANLS)	DM011041
	IF(.NOT.BODY) GO TO 655	DM011042
	WRITE(6,725)	DM011043
	DO 650 K=NPANLS,NWBP	DM011044
650	WRITE(6,705) K,XCPT(K),YCPT(K),ZCPT(K),THU(K=NPANLS),	DM011045
	1 THV(K=NPANLS),THW(K=NPANLS)	DM011046
655	CONTINUE	DM011047
C		DM011048
C		DM011049
C		DM011050
C	CALCULATE LOADINGS ON THE WINGS OR FINS WITH LINEAR PRESSURE	DM011051
C	LOADINGS	DM011052
C		DM011053
	IF (NPRESS.EQ.0) CALL LOADS	DM011054
C		DM011055
C		DM011056
C	NON LINEAR PRESSURE LOADING CALCULATION	DM011057
C	NVRTPLEB MEANS EXCLUDE VORTEX INDUCED VELOCITIES PARALLEL TO WING	DM011058
C	SURFACES	DM011059
C		DM011060
C		DM011061
C		DM011062
	IF (NOLINP.NE.0) CALL SPECPR	DM011063
C		DM011064
C	CONTINUE CALCULATION OF PRESSURES ON THE BODY MERIDIANS IN THE	DM011065
C	REGION AFT OF LEADING EDGES OF FIN-BODY JUNCTIONS.	DM011066
C	BOYAFT IS ENTRY POINT IN SUBROUTINE BOYPR	DM011067
C		DM011068
	IF (BODY.AND.NBOYPR.NE.0) CALL BOYAFT(ITAIL,XSTART)	DM011069
C		DM011070
C		DM011071
	GO TO 999	DM011072
	END	DM011073

	SUBROUTINE HOYGEN	DM02	1
C		DM02	2
C	VERSION:DEMON2.	DM02	3
C		DM02	4
C	THIS SUBROUTINE DETERMINES STRENGTHS OF SUPERSONIC LINEARLY	DM02	5
C	VARYING LINE SOURCES/SINKS AND LINE DOUBLET TO MODEL A BODY OF	DM02	6
C	REVOLUTION AT GIVEN INCLUDED ANGLE OF ATTACK AND MACH NUMBER.	DM02	7
C		DM02	8
C	DIMENSION A(100)	DM02	9
C		DM02	10
C	LOGICAL ASYM,DUMBDY,DELTA,NOSYM	DM02	11
C		DM02	12
	COMMON/ONE/DUM1(6402),ALFR,ARWING,B2,DUM2(9),FMACH,FR,DUM3(3),	DM02	13
	1 TLRNC,TIPY,10TLR,DUM4(18),	DM02	14
	2 NRIP,DUM5(2),NDRAG,DUM6(4),NOCPT,NOLINP,NOUT,NPANLS,NPRESS,NWBP,	DM02	15
	2ASYM,DUMBDY,DELTA,NOSYM	DM02	16
	COMMON/TWO/IX(101),UBD(101),VBS(101),VBD(101),VHS(101),VTHD(101),	DM02	17
	1XBODY(101),RBDY(101),RPHDY(101),DPCY(100),T(100),TC(100),COEFF	DM02	18
	2(5),BCODE,HETASQ,HSQ,RADIUS,RFIELD,DUM7 ,U,V,VT,LNOSE,MACH,MACHSQ,	DM02	19
	3BETA,XFIELD,X2,LBODY,NXBODY	DM02	20
	COMMON/THREE/THI(125),X*LE	DM02	21
	COMMON/SPSANG/SINALC,COSALC,SINPHI,COSPHI	DM02	22
	COMMON/FOUR/XF(100),RF(100)	DM02	23
C		DM02	24
C		DM02	25
C	REAL MACH,MACHSQ,LNOSE,LBODY,LBDYR	DM02	26
C		DM02	27
C	INTEGER BCODE	DM02	28
C		DM02	29
C		DM02	30
C	NAMelist/HOBY/NXBODY,LNOSE,LBODY,BCODE	DM02	31
C		DM02	32
C		DM02	33
C		DM02	34
	6 FORMAT(I4,F9.4,I0G11.4)	DM02	35
	227 FORMAT(1H0,53HVELOCITIES INDUCED ON BODY BY BODY LINE SINGULARITIES	DM02	36
	19 FOR MACH=,F7.4,5X,6HALFAC=,F7.4//20X,12HBODY SOURCES,25X,13HBODY	DM02	37
	2 DOUBLET, //9X,1HX,5X,1HU,10X,1HV,10X,2HVN,9X,1HU,9X,1HV,10X,	DM02	38
	3 2HVT, 9X,2HVN//	DM02	39
	700 FORMAT(1X,4(1H=),22HBODY DEFINITION POINTS,7(1H=),3X,10(1H=),	DM02	40
	1 14HCONTROL POINTS,9(1H=)/3X,1HI,6X,5HXBODY,6X,5HRRBODY,5X,	DM02	41
	2 6HRRBODY,12X,2HXF,9X,2HMF,6X,5HRR/DX//)	DM02	42
	701 FORMAT(1X,13,1X,F10.4,1X,F10.4,1X,F10.4,4X,F10.4, 1X,F10.4,1X,	DM02	43
	1 F10.4)	DM02	44
	702 FORMAT(20X,20H***REVISED LAYOUT***//)	DM02	45
	703 FORMAT(1H1)	DM02	46
	704 FORMAT (//,9X,54HBODY MERIDIAN=BODY NOSE MACH CONE INTERSECTION AT	DM02	47
	1 X = ,F10.5//)	DM02	48
	799 FORMAT(1H1,89HPHYSICAL DIMENSIONS OF BODY AND LINE SINGULARITY STR	DM02	49
	1NGTHS REPRESENTING THE BODY AT MACH=,F7.4,5X,7HALFAC= ,F7.4/	DM02	50
	2 9X,1HX,12X,1HR,11X,5HRR/DX,12X,2HTX,10X,4HT(I),10X,5HTC(I))	DM02	51
	801 FORMAT(I4,F9.4, 5G15.5)	DM02	52
	802 FORMAT (1H1,48HBODY RADIUS TOO LARGE IN RELATION TO BODY LENGTH//)	DM02	53
	803 FORMAT(///5X,63HMACH CONE=BODY MERIDIAN INTERSECTION NOT FOUND AFT	DM02	54
	1ER 100 TRIALS//)	DM02	55
C		DM02	56
C		DM02	57
	MACH=FMACH	DM02	58
	RADIUS=RR	DM02	59
C		DM02	60
C	READ NAMELIST BODY	DM02	61
C		DM02	62

C	READ(5,BODY)	DM02 63
C		DM02 64
C	WRITE(6,BODY)	DM02 65
	IF (NXBODY,LE,0,OR,NXBODY,GT,101)NXBODY=51	DM02 66
		DM02 67
C		DM02 68
C	INITIALIZE DOUBLET STRENGTHS	DM02 69
C		DM02 70
C	DO 103 I=1,NXBODY	DM02 71
	103 TC(I)=0.0	DM02 72
C		DM02 73
C	CALCULATION OF AERODYNAMIC DATA	DM02 74
C		DM02 75
	MACHSQ=MACH*MACH	DM02 76
	BETASQ=MACHSQ-1.0	DM02 77
	BETA=SQRT(BETASQ)	DM02 78
	ALPHA=ASIN(SINALC)	DM02 79
	ALFAC=ALPHA*57.2957795	DM02 80
	N=NXBODY-1	DM02 81
	XBODY(1)=0.0	DM02 82
	XBODY(NXBODY)=LBODY	DM02 83
		DM02 84
C		DM02 85
C		DM02 86
C	HAIL OUT IF MACH CONE FROM NOSE TIP LIES INSIDE THE ENTIRE LENGTH	DM02 87
C	OF THE BODY	DM02 88
C		DM02 89
	IF (BETA*RADIUS,GE,LBODY) GO TO 200	DM02 90
	GO TO 204	DM02 91
	200 WRITE (6,802)	DM02 92
	STOP	DM02 93
	204 CONTINUE	DM02 94
C		DM02 95
C	SETUP OF POINTS ON BODY AXIS BY DIVIDING BODY LENGTH INTO N EQUAL	DM02 96
C	SEGMENTS	DM02 97
C		DM02 98
	DEL=LBODY/N	DM02 99
	DO 33 I=2,N	DM02 100
	33 XBODY(I)=XBODY(I-1)+DEL	DM02 101
		DM02 102
C		DM02 103
C	CALCULATION OF BODY RADII AND STREAM WISE SLOPES AT THE X-STATIONS	DM02 104
C	OF THE AXIS POINTS.	DM02 105
C	THEY ARE THE COORDINATES AND SLOPE AT THE BODY DEFINITION POINTS	DM02 106
C		DM02 107
	DO 35 I=1,NXBODY	DM02 108
	35 CALL BODYR(XBODY(I),RBODY(I),RPBODY(I))	DM02 109
C		DM02 110
C	NOW DETERMINE SLOPES DR/DX AT THE CONTROL POINTS TAKEN MID-WAY	DM02 111
C	BETWEEN THE BODY DEFINITION POINTS	DM02 112
C		DM02 113
	DO 36 I=1,N	DM02 114
	XF(I)=.5*(XBODY(I+1)+XBODY(I))	DM02 115
	CALL BODYR(XF(I),RF(I),DRDX(I))	DM02 116
	36 CONTINUE	DM02 117
	IF (ROUT,NE,1) GO TO 9	DM02 118
	WRITE(6,703)	DM02 119
	WRITE(6,700)	DM02 120
	WRITE(6,701) (I,XBODY(I),RBODY(I),RPBODY(I),XF(I),RF(I),	DM02 121
	DRDX(I),I=1,N)	DM02 122
	WRITE(6,701) NXBODY,XBODY(NXBODY),RBODY(NXBODY),RPBODY(NXBODY)	DM02 123
	9 CONTINUE	DM02 124
C		DM02 125

C	NEXT LOOP DETERMINES THE LOCATIONS OF THE ORIGINS OF THE LINEARLY	DM02 126
C	VARYING LINE SOURCES/SINKS AND DOUBLET.	DM02 127
C	THEIR STARTING POINTS ARE GIVEN BY TX(I)	DM02 128
C		DM02 129
	DO 10 I=1,NXBODY	DM02 130
	10 TX(I)=XBODY(I)-BETA*WBODY(I)	DM02 131
C		DM02 132
C	IF CONTROL POINTS LIE OUTSIDE THE MACH CONE WITH ITS ORIGIN AT THE	DM02 133
C	BODY NOSE, REVISE LAY-OUT OF BODY DEFINITION POINTS ETC.	DM02 134
C		DM02 135
	IF(BETA*RF(1),LT,XF(1))GO TO 199	DM02 136
C		DM02 137
C	DETERMINE X-STATION OF INTERSECTION OF BODY NOSE MACH CONE	DM02 138
C	WITH BODY	DM02 139
C		DM02 140
	DO 37 I=2,N	DM02 141
	IF((BETA*RF(1)-XF(1)),LT,0.0) GO TO 38	DM02 142
	37 CONTINUE	DM02 143
	38 IAFI=I	DM02 144
	IBFI=I-1	DM02 145
	DELTX=(XF(IAFI)-XF(IBFI))*0.1	DM02 146
	ITRY=0	DM02 147
	XTRY=XF(IBFI)	DM02 148
	40 RMCNE=XTRY/BETA	DM02 149
	CALL BODYR(XTRY,RI,SLPE)	DM02 150
	ITRY=ITRY+1	DM02 151
	ERR=RI-RMCNE	DM02 152
	IF(ITRY,GE,100) GO TO 42	DM02 153
	IF(ERR,LT,0.0) GO TO 39	DM02 154
	XTRY=XTRY+DELTX	DM02 155
	GO TO 40	DM02 156
	42 WRITE(6,803)	DM02 157
	STOP	DM02 158
	39 IF(ABS(ERR),LT,(.01*RI)) GO TO 41	DM02 159
	XTRY=XTRY-DELTX	DM02 160
	DELTX=0.1*DELTX	DM02 161
	GO TO 40	DM02 162
	41 XI=XTRY	DM02 163
C		DM02 164
C	REVISE LAYOUT OF BODY DEFINITION POINTS, CONTROL POINTS, AND	DM02 165
C	ORIGINS OF LINE SINGULARITIES	DM02 166
C		DM02 167
	LWBODY=LWBODY-XI	DM02 168
	DEL=LWBODY/N	DM02 169
	WBODY(2)=XI+DEL	DM02 170
	DO 43 I=3,N	DM02 171
	43 WBODY(I)=WBODY(I-1)+DEL	DM02 172
C		DM02 173
	DO 44 I=1,NWBODY	DM02 174
	44 CALL BODYR(WBODY(I),WBODY(I),WBODY(I))	DM02 175
C		DM02 176
	XF(1)=0.5*(XI+WBODY(2))	DM02 177
	CALL BODYR(XF(1),RF(1),OROX(1))	DM02 178
	DO 45 I=2,N	DM02 179
	XF(I)=0.5*(WBODY(I)+WBODY(I+1))	DM02 180
	CALL BODYR(XF(I),RF(I),OROX(I))	DM02 181
	45 CONTINUE	DM02 182
	IF(MOUT,NE,1) GO TO 455	DM02 183
	WRITE(6,703)	DM02 184
	WRITE(6,702)	DM02 185
	WRITE(6,704) XI	DM02 186
	WRITE(6,700)	DM02 187

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      WRITE(6,701) (I,XBODY(I),RBODY(I),RPRBODY(I),XF(I),RF(I),
1  DROX(I),I=1,N)
      WRITE(6,701) NXBODY,XBODY(NXBODY),RBODY(NXBODY),RPRBODY(NXBODY)
455  CONTINUE
      TX(1)=0.0
      DO 46 I=2,NXBODY
46  TX(I)=XBODY(I)-BETA*PRBODY(I)
199  CONTINUE
C
C      DETERMINATION OF SOURCE STRENGTHS AT CONTROL POINTS MIDWAY BETWEEN
C      BODY DEFINITION POINTS.
C
C      CALCULATION OF THE FIRST SOURCE STRENGTH.
C
      XFELD=XF(1)
      RFELD=RF(1)
      SLOPE=DROX(1)
      RSQ=BETASQ*RFELD*RFELD
      X2=XFELD-LHODY
      CALL SOURCE(1)
      A(1)=V*SLOPE*U
      T(1)=(DROX(1)/A(1)
C
C      CALCULATION OF THE REST OF SOURCE STRENGTHS.
C
      DO 210 I=2,N
      XFELD=XF(I)
      RFELD=RF(I)
      SLOPE=DROX(I)
      RSQ=BETASQ*RFELD*RFELD
      X2=XFELD-LHODY
      DO 205 J=1,I
      CALL SOURCE(J)
205  A(J)=V*SLOPE*U
      SUM=0.
      IM=I-1
      DO 201 J=1,IM
201  SUM=T(J)+A(J)+SUM
210  T(I)=(DROX(I)-SUM)/A(I)
      T(NXBODY)=0.0
C
C      DETERMINATION OF DOUBLET STRENGTHS AT CONTROL POINTS MIDWAY
C      BETWEEN BODY DEFINITION POINTS
C
C      CALCULATION OF THE FIRST DOUBLET STRENGTH.
C
      IF (ABS(ALPHA).LT.1.0E-10.OR.RB.LT.(0.1+H2)) GO TO 798
      XFELD=XF(1)
      RFELD=RF(1)
      SLOPE=DROX(1)
      RSQ=BETASQ*RFELD*RFELD
      X2=XFELD-LHODY
      CALL DOUBLET(1)
      A(1)=SLOPE*U-V
      TC(1)=4(LPH4/A(1)
C
C      CALCULATION OF THE REST OF THE DOUBLET STRENGTHS.
C
      DO 215 I=2,N
      XFELD=XF(I)
      RFELD=RF(I)
      SLOPE=DROX(I)
      RSQ=BETASQ*RFELD*RFELD

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X2=XFIELD-LBODY	DM02 251
DO 212 J=1,I	DM02 252
CALL DDUBLT(J)	DM02 253
212 A(J)=SLOPE*H*V	DM02 254
SUM=0.	DM02 255
IM1=I-1	DM02 256
DO 203 J=1,IM1	DM02 257
203 SUM=TC(J)+A(J)+SUM	DM02 258
215 TC(I)=(ALPHA*SUM)/A(I)	DM02 259
TC(NXBODY)=0.0	DM02 260
798 CONTINUE	DM02 261
C	DM02 262
C PRINT OUT OF BODY CHARACTERISTICS	DM02 263
C	DM02 264
WRITE(6,799)MACH,ALFAC	DM02 265
DO 800 I=1,NXBODY	DM02 266
800 WRITE(6,801) I,XBODY(I),RBODY(I),RPHODY(I),TX(I),T(I),TC(I)	DM02 267
C	DM02 268
C COMPUTATION OF VELOCITIES INDUCED ON BODY BY BODY SOURCES AND	DM02 269
C DOUBLET AT BODY DEFINITION POINTS, THT=0 DEGR. MEANS LFEWARD SIDE	DM02 270
C	DM02 271
IF(NOUT.EQ.0) RETURN	DM02 272
WRITE(6,227)MACH,ALFAC	DM02 273
C	DM02 274
C COSTH,SINTH ARE COSINE AND SINE,RESPECTIVELY, OF THE STREAMWISE	DM02 275
C BODY SLOPE ANGLE.	DM02 276
C	DM02 277
DO 225 I=1,NXBODY	DM02 278
COSTH=SQRT(1./(RPHODY(I)**2+1.))	DM02 279
SINTH=SQRT(1.-COSTH*COSTH)	DM02 280
XFIELD=XBODY(I)	DM02 281
RFIELD=RBODY(I)	DM02 282
IF(RFIELD.GT.0. )GO TO 214	DM02 283
C	DM02 284
C IF THE FIELD POINT IS ON THE AXIS, THEN WE SHIFT OUT TO AVOID THE	DM02 285
C SINGULARITY IN THE VELOCITY FUNCTION ON THE AXIS.	DM02 286
C	DM02 287
IF(I.EQ.NXBODY)GO TO 221	DM02 288
RFIELD=RBODY(I+1)/10.	DM02 289
XFIELD=XFIELD+(XBODY(I+1)-XBODY(I))/10.	DM02 290
GO TO 214	DM02 291
221 RFIELD=RBODY(I-1)/10.	DM02 292
XFIELD=XFIELD-(XBODY(I)-XBODY(I-1))/10.	DM02 293
214 RSQ=RETASQ*RFIELD*RFIELD	DM02 294
X2=XFIELD-LBODY	DM02 295
C	DM02 296
C VELOCITIES UD,VD ARE CALCULATED ON THE BODY OPPOSITE THE CROSS	DM02 297
C FLOW STREAM VECTOR (LFEWARD SIDE)	DM02 298
C VELOCITY VTD IS CALCULATED AT 90 DEGREES FROM THE CROSS FLOW	DM02 299
C STREAM DIRECTION	DM02 300
C	DM02 301
US=0.	DM02 302
VS=0.	DM02 303
UD=0.	DM02 304
VD=0.	DM02 305
VTD=0.	DM02 306
DO 218 J=1,I	DM02 307
CALL SOURCE(J)	DM02 308
US=US+T(J)*U	DM02 309
VS=VS+T(J)*V	DM02 310
CALL DDUBLT(J)	DM02 311
UD=UD+U*TC(J)	DM02 312
VD=VD+V*TC(J)	DM02 313

C		DM02	314
C	VNS,VND ARE INDICATORS OF LEAKAGE THROUGH THE BODY SURFACE	DM02	315
C	AT THE BODY DEFINITION POINTS.	DM02	316
C	NOTE: THE BOUNDARY CONDITION IS SATISFIED AT THE CONTROL POINTS IN	DM02	317
C	BETWEEN THE BODY DEFINITION POINTS.	DM02	318
C		DM02	319
	218 VTD=VTD+VT*TC(J)	DM02	320
	IF(RPHODY(I).LT.0.)GO TO 220	DM02	321
	VNS=VS*COSTH=(1.+US)*SINTH	DM02	322
	VND=(VD+ALPHA)*COSTH=UD*SINTH	DM02	323
	GO TO 222	DM02	324
	220 VNS=VS*COSTH+(1.+US)*SINTH	DM02	325
	VND=(VD+ALPHA)*COSTH+US*SINTH	DM02	326
	222 UBS(I)=US	DM02	327
	VBS(I)=VS	DM02	328
	UBD(I)=UD	DM02	329
	VBD(I)=VD	DM02	330
	VTHD(I)=VTD	DM02	331
	225 WRITE(6,6) I,XBODY(I),US,VS,VNS,UD,VD,VTD,VND	DM02	332
	RETURN	DM02	333
	END	DM02	334

	SUBROUTINE BODYPR(ITAIL,XSTART)	DM03	1
C		DM03	2
C	VERSION:DEMON2.	DM03	3
C		DM03	4
C	THIS SUBROUTINE COMPUTES LINEAR AND BERNOULLI PRESSURES AT POINTS	DM03	5
C	ON THE BODY SURFACE.	DM03	6
C	THE POINTS LIE ON BODY MERIDIANS. THEIR X-COORDINATES ARE A SUBSET	DM03	7
C	OF THE X-COORDINATES OF THE BODY CONTROL POINTS (XF(I),PF(I))	DM03	8
C	DETERMINED IN SUBROUTINE BODYGEN.	DM03	9
C	THE DENSITY OF THE POINTS IS TAKEN AS HALF THE DENSITY OF	DM03	10
C	THE BODY SINGULARITIES.	DM03	11
C	WHERE THE BODY	DM03	12
C	IS COVERED WITH INTERFERENCE PANELS, THE POINTS COINCIDE WITH	DM03	13
C	THE PANEL CONTROL POINTS. THE BODY MERIDIANS ON WHICH THE	DM03	14
C	POINTS LIE PASS THROUGH THE CONTROL POINTS OF THE BODY	DM03	15
C	INTERFERENCE PANELS. THE NUMBER OF BODY MERIDIANS IS EQUAL TO	DM03	16
C	NBDCR. THAT IS, THE NUMBER OF BODY INTERFERENCE PANELS ON THE	DM03	17
C	BODY CIRCUMFERENCE.	DM03	18
C		DM03	19
C		DM03	20
C		DM03	21
C	DIMENSION THETO(100)	DM03	22
C		DM03	23
C		DM03	24
C	LOGICAL BODY,NOSYM	DM03	25
C		DM03	26
C		DM03	27
	COMMON/ONE/CIRC(250),DELTP(250),FN(250),PNLC(250),SWPPLF(250),	DM03	28
	18WPPTE(250),VNDR(250),XBAR(250),ZBAR(250),XCPT(250),YCPT(250),ZCPT	DM03	29
	2(250),XLF(250),XLH(250),XHF(250),XRR(250),YLC(250),YRC(250),ZLF(250)	DM03	30
	30),ZHF(250),ZLH(250),ZRH(250),SNT(125),CST(125),SNT2(125),CST2(125)	DM03	31
	4),IP(300),XFBIP(100),A,ALFA,ALFR,AKWING,H2,H2V,HETA,HETAR,CONST,	DM03	32
	SCOSALF,COSHET,CN,UX,EM,FNACH,RCIR,SINALF,SINHET,SLOPE,TLRNC,TIPY,	DM03	33
	6TOTLR,U,V,W,UCHK,VCHK,WCHK,XHIP,X,Y,Z,I,IF,IT,J,MSWR,MSWL,MSWU,	DM03	34
	7MSWD,NRIP,NCRX,NCW,NDRAG,NHP,NPR,NRP,N3P,NOCPT,NOLIN,NOUT,NPANELS,	DM03	35
	8NPRESS,NARP,ASYM,BODY,DELTAS,NOSYM	DM03	36
	COMMON/SWEEPS/VSWLER(20),VSWTER(20),VSWLEL(20),VSWTEL(20),	DM03	37
	1 VSWLEH(20),VSWTEU(20),VSWLED(20),VSWTFD(20),LVSWP,LEFT,FAC,NCWH,	DM03	38



	2ARPAL(250),*IDTH(250)	DM03	39
	COMMON/AVEL/ROU(150),ROV(150),ROW(150),XFLDP(150),YFLDP(150),	DM03	40
	1 ZFLDP(150)	DM03	41
	COMMON/SPSANG/SINALC,COSALC,SINPHI,COSPHI	DM03	42
	COMMON/WHTR/THI(125),X*LE	DM03	43
	COMMON/TWO/TX(101),UBD(101),UHS(101),VBD(101),VHS(101),VTHD(101),	DM03	44
	1XBODY(101),RBODY(101),RRBODY(101),URDX(100),T(100),TC(100),COEFF	DM03	45
	2(5),ACODE,HETASQ,BSQ,RADIUS,WFIELD,WNOSE,DUMVEL(3),LNOSE,MACH,	DM03	46
	3MACHSQ,DMBETA,XFIELD,Y2,LBODY,NXBODY	DM03	47
	COMMON /WHTR1/ XF(100),WF(100)	DM03	48
	COMMON/VRTXV/VVRTX(150),*VRTX(150),*VRTPL,NVRTX,VRTMAX	DM03	49
	COMMON/TWKDAT/NTDAT,NCWT,NTPR,MSAT(4),NRPT,NHPT,N3PT,NTHP,ASYMT,	DM03	50
	1 NVERT,SWLET(20,4),S*LET(20,4),YTH(20,4),THETAL(400)	DM03	51
	COMMON/ICVEL/UTCHK,VTCHK,WCHK,IIT,IET,IJ	DM03	52
	COMMON/VPTHVL/VVEL(500),*VEL(500),JCPT,NCPDUT,NVLIN	DM03	53
	COMMON/VORSPC/GAMMA(10),YVRTX(10),ZVRTX(10),RLNC	DM03	54
	COMMON/ELLIPS/RA,RB,ERATIO	DM03	55
C		DM03	56
C		DM03	57
	REAL LBODY	DM03	58
C		DM03	59
C		DM03	60
	DATA RADTOD/57.2457795/	DM03	61
C		DM03	62
C		DM03	63
C		DM03	64
	700 FORMAT(1H1,25X,49HPRESSURE COEFFICIENTS AT POINTS ON BODY MERIDIAN	DM03	65
	13//)	DM03	66
	701 FORMAT (//45X,10HBODY RING=,1X,I3/)	DM03	67
	702 FORMAT(1X,I3,12F10.5)	DM03	68
	703 FORMAT (2X,1HJ,4X,6H*ETA,,5X,2HX9,6X,2H*H,8X,2H*ZB,8X,4H*UT,6X,	DM03	69
	1 4H*VT,6X,4H*VT,4X,7HCP,LIN,,3X,8HCP,BERN,,3X,5HDP/OX,5X,	DM03	70
	2 7HDP/PINF,,3X,7HDP/PINF,/8X,4HCEG,,97X,5HBERN,,5X,4H*LIN,/) )	DM03	71
	704 FORMAT (1H1,106(1H*)/1X,37H*FT OF LEADING EDGE OF FIN ROOTCOORDS)	DM03	72
	705 FORMAT (1X,I5,3(2X,F10.5),2(2X,F12.5))	DM03	73
	706 FORMAT (/40X,46HRIGHT VORTEX STRENGTH GAMMA/(2*PI*RLOC*VIN*F)= ,	DM03	74
	1 F10.5/	DM03	75
	2 40X,46HRIGHT VORTEX Y(ROLLED COORDS.)/RLOC = ,	DM03	76
	3 F10.5/	DM03	77
	4 40X,46HRIGHT VORTEX Z(ROLLED COORDS.)/RLOC = ,	DM03	78
	5 F10.5/	DM03	79
	6 40X,46HLEFT VORTEX STRENGTH GAMMA/(2*PI*RLOC*VIN*F) = ,	DM03	80
	7 F10.5/	DM03	81
	8 40X,46HLEFT VORTEX Y(ROLLED COORDS.)/RLOC = ,	DM03	82
	9 F10.5/	DM03	83
	1 40X,46HLEFT VORTEX Z(ROLLED COORDS.)/RLOC = ,	DM03	84
	2 F10.5/)	DM03	85
	745 FORMAT (15,5E12.5)	DM03	86
	746 FORMAT (15,5E12.5)	DM03	87
	747 FORMAT (///10X,38HTOTAL NUMBER OF PRESSURE POINTS,JCPT= ,14)	DM03	88
	748 FORMAT (1H1,10X,73HPOINT COORDINATES AND PERTURBATION VELOCITIES COM	DM03	89
	1ALCULATED BY PROGRAM VPATH//,	DM03	90
	2 5X,2HIC,5X,3H*CP,9X,3H*YCP,9X,3H*ZCP,8X,8H*VEL(IC),6X,8H*VEL(IC)/)	DM03	91
		DM03	92
		DM03	93
		DM03	94
		DM03	95
	IF (.NOT.BODY) RETURN	DM03	96
	FACTR1=1.428571429/(FMACH*FMACH)	DM03	97
	FACTR2=0.2*FMACH*FMACH	DM03	98
	DEGTOR=1.0/RADTOD	DM03	99
	ALFAC=ASIN(SINALC)*RADTOD	DM03	100
	THETAN=ATAN(RBODY(1))*RADTOD	DM03	101
	PINF=XWLE/(2.0*RB)	DM03	102
	XA=X*LF/RB	DM03	102

C	NCPT=1	DM03 103
C		DM03 104
C		DM03 105
C	NOTE: UP TO ENTRY HOYAT, FOLLOWING APPLIES TO CIRCULAR CROSS SECTION	DM03 106
C	HOODIES ONLY.	DM03 107
C	SET UP ARRAY OF COORDINATES IN WING COORDINATE SYSTEM FOR	DM03 108
C	THE PRESSURE POINTS AHEAD OF THE WING- OR FIN-HOODY JUNCTION.	DM03 109
C	CALCULATE VELOCITY COMPONENTS IN BODY COORDINATE SYSTEM.	DM03 110
C	THEN CALCULATE PRESSURE COEFFICIENTS.	DM03 111
C		DM03 112
C	READ IN PERTURBATION VELOCITIES CALCULATED BY PROGRAM VPATH2	DM03 113
C	IF NVLIN IS NOT ZERO.	DM03 114
C	ONLY APPLICABLE WHEN TAIL IS UNDER CONSIDERATION.	DM03 115
C		DM03 116
C	IF (NVLIN.EQ.0.OR ,ITAIL.EQ.0) GO TO 8	DM03 117
C	REWIND 7	DM03 118
C	WRITE (6,748)	DM03 119
C	DO 9 I=1,JCPT	DM03 120
C	READ (7,746) IC,XCP,YCP,ZCP,VVEL(IC),WVEL(IC)	DM03 121
C	9 WRITE (6,705) IC,XCP,YCP,ZCP,VVEL(IC),WVEL(IC)	DM03 122
C	8 CONTINUE	DM03 123
C		DM03 124
C	WRITE(6,700)	DM03 125
C	WRITE (6,703)	DM03 126
C	NRING=NRJP/NCWB	DM03 127
C	NRINGD=2*NRING	DM03 128
C	IF (.NOT.NOSYM) NRINGD=NRINGD+1	DM03 129
C	NHALF=NXBODY/2	DM03 130
C	DTHEAT=THTI(1)/2,0	DM03 131
C	ANBODY=NXBODY	DM03 132
C	DELX=LBODY/(ANBODY-1,0)	DM03 133
C	IF (ITAIL.EQ.1) GO TO 5	DM03 134
C	JCPT=0	DM03 135
C	ISTART=1	DM03 136
C	IL=0	DM03 137
C	GO TO 6	DM03 138
C	5 JCPT=NWRP	DM03 139
C	ISTART=(XSTANT/(DELX*2,0))+2	DM03 140
C	6 CONTINUE	DM03 141
C		DM03 142
C		DM03 143
C		DM03 144
C	WRITE DATA-SET CONTAINING CONTROL POINTS.	DM03 145
C		DM03 146
C	IF (ITAIL.EQ.0.AND,NCPOUT.EQ.0) GO TO 7	DM03 147
C	DO 21 IXSTAT=ISTART,NHALF	DM03 148
C	ICPT=(IXSTAT-1)*2+1	DM03 149
C	XPT=XF(ICPT)-XWLE	DM03 150
C	IF (XPT.GE.0.01) GO TO 22	DM03 151
C	DO 23 J=1,NRINGD	DM03 152
C	23 JCPT=JCPT+1	DM03 153
C	21 CONTINUE	DM03 154
C	22 CONTINUE	DM03 155
C	WRITE(6,747) JCPT	DM03 156
C	REWIND 4	DM03 157
C	WRITE(6,745) JCPT	DM03 158
C	WRITE(6,745) (J,XCPT(J),YCPT(J),ZCPT(J),J=1,NWRP)	DM03 159
C	JCPT=NWRP	DM03 160
C	7 CONTINUE	DM03 161
C		DM03 162
C		DM03 163
C		DM03 164
C	DO 10 IXSTAT=ISTART,NHALF	DM03 165
C	ICPT=(IXSTAT-1)*2+1	DM03 166
C	XPT=XF(ICPT)-XWLE	DM03 166

IF(XPT,GE,0.0) GO TO 13	DM03 167
WRITE(6,701) IXSTAT	DM03 168
DO 11 JPOLAR=1,NRING	DM03 169
JOBLE=JPOLAR*2	DM03 170
JOM1=JOBLE-1	DM03 171
THETO(JOM1)=THTI(JPOLAR)-0THETA	DM03 172
THETO(JOBLE)=THTI(JPOLAR)	DM03 173
THETEV=THETO(JOBLE)*DEGTOR	DM03 174
THETOD=THETO(JOM1)*DEGTOR	DM03 175
YPTEV=RF(ICPT)*COS(THETEV)	DM03 176
YPTOD=RF(ICPT)*COS(THETOD)	DM03 177
ZPTEV=RF(ICPT)*SIN(THETEV)	DM03 178
ZPTOD=RF(ICPT)*SIN(THETOD)	DM03 179
C	DM03 180
C NOTE: XFLOP,YFLOP,ZFLOP ARE IN THE WING COORDINATE SYSTEM.	DM03 181
C	DM03 182
XFLOP(JOM1)=XPT	DM03 183
XFLOP(JOBLE)=XPT	DM03 184
YFLOP(JOM1)=YPTOD	DM03 185
YFLOP(JOBLE)=YPTEV	DM03 186
ZFLOP(JOM1)=ZPTOD	DM03 187
11 ZFLOP(JOBLE)=ZPTEV	DM03 188
C	DM03 189
C IF TRUSYM IS TRUE, ADD FIELDPOINT AT 270 DEGREES	DM03 190
C TO COORDINATE ARRAYS.	DM03 191
C	DM03 192
IF(NOSYM) GO TO 25	DM03 193
DO 20 J=1,NRING	DM03 194
JJ=NRINGD-J	DM03 195
XFLOP(JJ+1)=XFLOP(JJ)	DM03 196
YFLOP(JJ+1)=YFLOP(JJ)	DM03 197
ZFLOP(JJ+1)=ZFLOP(JJ)	DM03 198
THETO(JJ+1)=THETO(JJ)	DM03 199
20 CONTINUE	DM03 200
XFLOP(NRING+1)=XPT	DM03 201
YFLOP(NRING+1)=0.0	DM03 202
ZFLOP(NRING+1)=-RF(ICPT)	DM03 203
THETO(NRING+1)=270.0	DM03 204
25 CONTINUE	DM03 205
C	DM03 206
C COMPUTE CONTRIBUTION TO VELOCITIES FROM BODY SINGULARITIES.	DM03 207
C HOU, HOV, HOW.	DM03 208
C	DM03 209
CALL VELCAL (NRINGD,ALFR,RETAR,1)	DM03 210
C	DM03 211
C NOTE: AHEAD OF THE FIN-BODY JUNCTION, NO INFLUENCE FROM CONSTANT	DM03 212
C U-VELOCITY OR SOURCE PANELS.	DM03 213
C	DM03 214
C	DM03 215
C ADD CONTRIBUTION FROM NOSE VORTICES IF APPLICABLE.	DM03 216
C THEIR INFLUENCE IS LIMITED TO THE DISTANCE ALONG THE BODY UP TO	DM03 217
C THE ROOTCHORD LE OF THE CANARDS.	DM03 218
C	DM03 219
IF (ITAIL,EQ,1) GO TO 19	DM03 220
IF (ABS(ALFAC),LE,4.0) GO TO 19	DM03 221
XGAMN=XF(ICPT)/RH	DM03 222
PLC=RF(ICPT)	DM03 223
CALL BODYVTX (ALFAC,THETAN,FINE,XA,FNACH,GAMN,1,XGAMN,YGAMN,	DM03 224
1 ZGAMN,XSA,IL)	DM03 225
IF (GAMN,FG,0.0) GO TO 19	DM03 226
NVRT=NVRTX	DM03 227
NVRTX=2	DM03 228
GAMMA(1)=GAMN	DM03 229
GAMMA(2)=-GAMN	DM03 230

YVRTX(1)=-ZGAMN*SINPHI+YGAMN*COSPHI	DM03 231
YVRTX(2)=-ZGAMN*SINPHI-YGAMN*COSPHI	DM03 232
ZVRTX(1)=ZGAMN*COSPHI+YGAMN*SINPHI	DM03 233
ZVRTX(2)=ZGAMN*COSPHI-YGAMN*SINPHI	DM03 234
WRITE (6,706) GAMMA(1),YVRTX(1),ZVRTX(1),	DM03 235
1 GAMMA(2),YVRTX(2),ZVRTX(2)	DM03 236
NCPT=1	DM03 237
CALL VORTEX (1,NRINGD)	DM03 238
NVRTX=NVRT	DM03 239
19 CONTINUE	DM03 240
C PRESSL=LINEAR PRESSURE COEFFICIENT	DM03 241
C PRESSB=BERNOULLI PRESSURE COEFFICIENT	DM03 242
C	DM03 243
DO 12 J=1,NRINGD	DM03 244
JCPT=JCPT+1	DM03 245
IC=JCPT	DM03 246
XBDY=XFLOP(J)+XWLE	DM03 247
IF (NOUT.NE.0)	DM03 248
1WRITE (6,702) J,THEID(J),XBDY,YFLOP(J),ZFLOP(J),BDU(J),BDV(J),	DM03 249
1 BDU(J)	DM03 250
UTOT=BDU(J)	DM03 251
VTOT=BDV(J)+VVRTX(J)	DM03 252
WTOT=BDW(J)+WVRTX(J)	DM03 253
IF (NOUT.NE.0)	DM03 254
1WRITE (6,702) J,THEID(J),XBDY,YFLOP(J),ZFLOP(J),UTOT,VTOT,WTOT	DM03 255
VTOT=VTOT+VVEL(IC)	DM03 256
WTOT=WTOT+WVEL(IC)	DM03 257
IF (NOUT.NE.0)	DM03 258
1WRITE (6,702) J,THEID(J),XBDY,YFLOP(J),ZFLOP(J),UTOT,VTOT,WTOT	DM03 259
PRESSL=2.0*UTOT	DM03 260
BDUSQ=UTOT*UTOT	DM03 261
BDVSQ=VTOT*VTOT	DM03 262
BDWSQ=WTOT*WTOT	DM03 263
URAR=UTOT*COSALC-VTOT*SINBET+WTOT*SINALF	DM03 264
ARG=1.0-FACTR2*(2.0*URAR+BDUSQ+BDVSQ+BDWSQ)	DM03 265
PRESSB=FACTR1	DM03 266
IF (ARG.GE.TOTLR) PRESSB=FACTR1*(ARG**3.5-1.0)	DM03 267
POPINF=PRESSB/FACTR1+1.0	DM03 268
PLINOP=PRESSL/FACTR1+1.0	DM03 269
1WRITE (6,702) J,THEID(J),XBDY,YFLOP(J),ZFLOP(J),UTOT,VTOT,WTOT,	DM03 270
PRESSL,PRESSB,DRDX(ICPT),POPINF ,PLINOP	DM03 271
C	DM03 272
C	DM03 273
C FINISH WRITING DATA-SET WITH BODY PRESSURE POINTS.	DM03 274
C APPLICABLE ONLY WHEN ITAIL=1 AND NCPOUT.NE.0.	DM03 275
C	DM03 276
C NOTE: THEY ARE SPECIFIED IN THE WING COORDINATE SYSTEM.	DM03 277
C	DM03 278
IF (ITAIL.EQ.1.AND.NCPOUT.NE.0)	DM03 279
1 WRITE (4,745) JCPT,XFLOP(J),YFLOP(J),ZFLOP(J)	DM03 280
C	DM03 281
VVRTX(J)=0.0	DM03 282
WVRTX(J)=0.0	DM03 283
12 CONTINUE	DM03 284
10 CONTINUE	DM03 285
13 CONTINUE	DM03 286
WRITE (6,747) JCPT	DM03 287
RETURN	DM03 288
C	DM03 289
C CALCULATE PRESSURE COEFFICIENTS AFT OF LEADING EDGE OF FIN-BODY	DM03 290
C JUNCTION AT CONTROL POINTS OF BODY INTERFERENCE PANELS.	DM03 291
C CONTROL POINT COORDINATES ARE IN WING SYSTEM.	DM03 292
C	DM03 293

C	ENTRY BODYAFT	DM03 294
C		DM03 295
C	WRITE (6,704)	DM03 296
C	WRITE (6,700)	DM03 297
C	WRITE (6,703)	DM03 298
C	DO 14 IHD=1,NBIP	DM03 299
C	JHD=IHD+NPNLS	DM03 300
C	XFLDP(IHD)=XCPT(JHD)	DM03 301
C	YFLDP(IHD)=YCPT(JHD)	DM03 302
C	14 ZFLDP(IHD)=ZCPT(JHD)	DM03 303
C		DM03 304
C	COMPUTE CONTRIBUTION TO VELOCITIES FROM BODY SINGULARITIES, HOU, H0V, H0W.	DM03 305
C	IF BODY HAS ELLIPTICAL CROSS SECTION, H0U, H0V, H0W ARE ALREADY READ IN BY ROUTINE CREHSD FROM A DATA SET. (SEE SUBROUTINE BODYRD)	DM03 306
C		DM03 307
C	IF (RA,EQ,RB) CALL VELCAL (NBIP,ALFR,REAR,1)	DM03 308
C		DM03 309
C		DM03 310
C		DM03 311
C		DM03 312
C	ADD EFFECTS OF 2-D TYPE VORTICES IF APPLICABLE	DM03 313
C	THEY HAVE BEEN CALCULATED ALREADY IN CREHSD.	DM03 314
C	(BY MEANS OF SUBROUTINE VRTVEL OR VVELS)	DM03 315
C		DM03 316
C	DO 18 K=1,NBIP	DM03 317
C	KK=K+NPNLS	DM03 318
C	IF (RA,EQ,RB) GO TO 16	DM03 319
C	H0U(K)=H0U(KK)	DM03 320
C	H0V(K)=H0V(KK)	DM03 321
C	H0W(K)=H0W(KK)	DM03 322
C	16 H0V(K)=H0V(K)+VVRTX(KK)	DM03 323
C	18 H0W(K)=H0W(K)+WVRTX(KK)	DM03 324
C		DM03 325
C		DM03 326
C	ADD CONTRIBUTION FROM SOURCE PANELS ON WINGS	DM03 327
C		DM03 328
C	IF (NTOAT,EQ,0) GO TO 35	DM03 329
C	IIT=1	DM03 330
C	IFT=INTHP	DM03 331
C	DO 30 K=1,NBIP	DM03 332
C	KJ=K	DM03 333
C	CALL THKVEL(XFLDP(K),YFLDP(K),ZFLDP(K))	DM03 334
C	H0U(K)=H0U(K)+UTCHK	DM03 335
C	H0V(K)=H0V(K)+VTCHK	DM03 336
C	H0W(K)=H0W(K)+WTCHK	DM03 337
C	30 CONTINUE	DM03 338
C	35 CONTINUE	DM03 339
C		DM03 340
C	CALCULATE CONTRIBUTION FROM CONSTANT U-VELOCITY PANELS ON BODY	DM03 341
C	INTERFERENCE SHELL AND WINGS OR FINS.	DM03 342
C	ADD IN VELOCITIES INDUCED BY MOVING VORTICES (IF APPLICABLE).	DM03 343
C		DM03 344
C		DM03 345
C		DM03 346
C		DM03 347
C		DM03 348
C	NPRNG=NBIP/NCNR	DM03 349
C	DTHETA=THTI(1)/2.0	DM03 350
C	FACTR1=1.428571429/(FMACH*FMACH)	DM03 351
C	FACTR2=0.2*FMACH*FMACH	DM03 352
C	DO 15 IL=1,NCNR	DM03 353
C	WRITE (6,701) IL	DM03 354
C	DO 17 JL=1,NPRNG	DM03 355
C	IHD=IHD+1	DM03 356

IC=NPANLS+IRD	DM03 357
THTSD=THTI(JL)=OTHET.	DM03 358
XBDY=XFLDP(IRD)+X*LE	DM03 359
IF (NDUT,NE,0)	DM03 360
WRITE (6,702) JL,THTSD,XBDY,YFLDP(IRD),ZFLDP(IRD),BDU(IRD),	DM03 361
BDV(IRD),BDW(IRD)	DM03 362
CALL VFLNDR (XFLDP(IRD),YFLDP(IRD),ZFLDP(IRD))	DM03 363
UTOT=UCHK+BDU(IRD)	DM03 364
VTOT=VCHK+BDV(IRD)+VVEL(IC)	DM03 365
WTOT=WCHK+BDW(IRD)+WVEL(IC)	DM03 366
IF (NDUT,NE,0)	DM03 367
WRITE (6,702) JL,THTSD,XBDY,YFLDP(IRD),ZFLDP(IRD),UTOT,VTOT,	DM03 368
WTOT	DM03 369
PRESSL=2.0*UTOT	DM03 370
HOUSS=UTOT*UTOT	DM03 371
BDVSS=VTOT*VTOT	DM03 372
BDWSS=WTOT*WTOT	DM03 373
UBAR=UTOT*COSALC=VTOT*SINBET+WTOT*SINALF	DM03 374
ARG=1.0-FACTR2*(2.0+UBAR+HOUSS+BDVSS+BDWSS)	DM03 375
PRESSB=FACTR1	DM03 376
IF (ARG,GE,TOTLR) PRESSB=FACTR1*(ARG**3.5-1.0)	DM03 377
POPINF=PRESSB/FACTR1+1.0	DM03 378
PLINOP=PRESSL/FACTR1+1.0	DM03 379
SLP=0.0	DM03 380
WRITE (6,702) JL,THTSD,XBDY,YFLDP(IRD),ZFLDP(IRD),UTOT	DM03 381
VTOT,WTOT,PRESSL,PRESSB,SLP,POPINF,PLINOP	DM03 382
17 CONTINUE	DM03 383
15 CONTINUE	DM03 384
RETURN	DM03 385
END	DM03 386

SUBROUTINE BOYRD(BDU,BDV,BDW,NWBP,NPANLS,NAGAIN)	DM04 1
C	DM04 2
C VERSION: DEMON2	DM04 3
C	DM04 4
C ROUTINE TO READ ELLIPTICAL CROSS SECTION BODY INDUCED VELOCITIES	DM04 5
C AT WING AND BODY INTERFERENCE SHELL.	DM04 6
C THEY ARE READ IN FROM TAPE4.	DM04 7
C	DM04 8
C DIMENSION BDU(NWBP),BDV(NWBP),BDW(NWBP)	DM04 9
C	DM04 10
C COMMON/ELLIPS/RA,RB,ERATIO	DM04 11
C	DM04 12
700 FORMAT (////,5X,54HBODY UNDER CONSIDERATION HAS ELLIPTICAL CROSS	DM04 13
SECTION./	DM04 14
2 5X,44HINTERFERENCE SHELL HAS FOLLOWING PROPERTIES://	DM04 15
3 5X,23HHORIZONTAL SEMI-AXIS = ,F10.5//	DM04 16
4 5X,23HVERTICAL SEMI-AXIS = ,F10.5/////	DM04 17
745 FORMAT(15,3E12,5)	DM04 18
750 FORMAT(////,10X,24HWARNING = NWCPT,NE,NWBP,76X,12H** BODYRD ** //	DM04 19
* 7H NWCPT=,15,7H XMACH=,F10.4,7H ALPHA=,F10.4)	DM04 20
C	DM04 21
C READ PAST CONTROL POINT COORDINATES.	DM04 22
C	DM04 23
C IF (NAGAIN,LE,0) REWIND 4	DM04 24
C IF (NAGAIN,LE,0) READ (4,745) NDUM	DM04 25
C IF (NAGAIN,LE,0) READ(4,745) (I,XPTJ,YPTJ,ZPTJ,J=1,NWBP)	DM04 26
C WRITE (6,700) RB,RA	DM04 27
C	DM04 28
C	DM04 29

C	READ VELOCITY COMPONENTS	DM04	30
C		DM04	31
	READ(4,745) NWCPT,XMACH,XALPHA	DM04	32
	IF (NWCPT,NE,NWHP) WRITE(6,750) NWCPT,XMACH,XALPHA	DM04	33
	READ(4,745) (I,RDU(J),RDV(J),ROW(J),J=1,NWCPT)	DM04	34
	RETURN	DM04	35
	END	DM04	36
C	SUBROUTINE RDVVTX (ALPHA0,THETAN,FINE,XA,EMACH,GAMN,NG,	DM05	1
	1 XGAMN,YGAMN,ZGAMN,XSA,IL)	DM05	2
C		DM05	3
C	VERSION: DEMON2	DM05	4
C		DM05	5
C	FOR BODIES WITH CIRCULAR CROSS SECTION ONLY	DM05	6
C	THIS SUBROUTINE COMPUTES STRENGTH AND POSITION IN THE CROSS FLOW	DM05	7
C	PLANE OF THE BODY NOSE VORTICES AS A FUNCTION OF AXIAL DISTANCE.	DM05	8
C	THE METHOD USED IS BASED ON EXPERIMENTAL DATA.	DM05	9
C	REFERENCE IS NASA CR-2473,1975.	DM05	10
C		DM05	11
C	DIMENSION XST(11),ZAI(11),YAI(11),YA2(11),GAMT(11)	DM05	12
C		DM05	13
	DATA XST/0.0,1.0,2.0,3.0,4.0,5.0,6.0,7.0,8.0,9.0,10.0/	DM05	14
	DATA GAMT/0.3,0.32,0.34,0.40,0.48,0.62,0.77,0.90,1.0,1.08,1.15/	DM05	15
	DATA YAI/,.45,.463,.477,.492,.505,0.52,.534,0.55,0.565,0.575,0.585/	DM05	16
	DATA YA2/,.63,.64,.653,.665,.678,.69,.7,.715,.725,.735,.74/	DM05	17
	DATA ZAI/1.14,1.26,1.38,1.5,1.615,1.75,1.84,1.95,2.05,2.14,2.20/	DM05	18
C		DM05	19
	701 FORMAT (//IX5H*****3X62HASYMMETRIC OR UNSTEADY BODY VORTEX SEPARATION	DM05	20
	1TION POSSIBLE *****//)	DM05	21
	702 FORMAT (40X,41HBODY NOSE SEPARATION AT XB/RB = ,F10.5/	DM05	22
	1 40X, 41HVORTEX STRENGTH GAMMA/(2*PI*RLOC*VINF) = ,F10.5/	DM05	23
	2 40X,41HVORTEX Y/RLOC (UNROLLED COORDS) = ,F10.5/	DM05	24
	3 40X,41HVORTEX Z/RLOC (UNROLLED COORDS) = ,F10.5/)	DM05	25
C		DM05	26
	IF (IL,GE,1) GO TO 16	DM05	27
	BDVVRT=1.0	DM05	28
	NTRLE=11	DM05	29
	DELTA=0.0	DM05	30
	F=1.0	DM05	31
	IF (ALPHA0,LT,0.0) F=-1.0	DM05	32
	ALPHA=F*ALPHA0	DM05	33
C		DM05	34
C	XSA=XSEPARATION/RB	DM05	35
C		DM05	36
	IF (THETAN,LE,30.0) GO TO 10	DM05	37
	XSA=10./(ALPHA =4.0) + 2.0	DM05	38
	GO TO 15	DM05	39
10	XSA=32.0 - SQRT(1024.0*(ALPHA =4.0)/(THETAN=4.0))	DM05	40
13	IF (XSA,LT,0.0) XSA=0.0	DM05	41
	IL=IL+1	DM05	42
	IF(XSA,GE,XA) BDVVRT=0.0	DM05	43
	IF(BDVVRT,EQ,0.0) GO TO 31	DM05	44
	IF (XSA,GE,XA) GO TO 31	DM05	45
C		DM05	46
C	COMPUTE UPPER LIMIT FOR SYMMETRIC VORTEX SEPARATION	DM05	47
C		DM05	48
	ALMT=((FINE=12.0)**2)/3.57 + 12.0	DM05	49
	IF (ALPHA ,GT,ALMT) WRITE (6,701)	DM05	50
	SNALP=SIN(ALPHA0/57.2957795)*F	DM05	51
16	CONTINUE	DM05	52
	IF(BDVVRT,EQ,0.0) GO TO 31	DM05	53

	XPAR=(XGAMN-XSA)*SNALP	DM05	54
	IF (XPAR,LT, 0.0) GO TO 31	DM05	55
C		DM05	56
C	INTERPOLATE IN DATA TABLES FOR THE X-STATION XGAMN*Y/RH.	DM05	57
C	GAMT=GAMMA/(2*PI*RLNC*VINP*SIN(ALFA))	DM05	58
C	VAL,YA2,ZA1 ARE DIVIDED BY RLNC.	DM05	59
C		DM05	60
	DO 20 J=1,NTABLE	DM05	61
	K=J	DM05	62
	IF (XPAR-XST(J)) 22,23,20	DM05	63
20	CONTINUE	DM05	64
23	GAMN =GAMT(K)*SNALP	DM05	65
	ZGAMN =ZA1(K)	DM05	66
	Y1=VA1(K)	DM05	67
	Y2=YA2(K)	DM05	68
	GO TO 30	DM05	69
22	DELTA=(XPAR-XST(K-1))/(XST(K)-XST(K-1))	DM05	70
	GAMN =GAMT(K-1) + DELTA*(GAMT(K)-GAMT(K-1))	DM05	71
	GAMN=GAMN*SNALP	DM05	72
	ZGAMN =ZA1(K-1) + DELTA*(ZA1(K)-ZA1(K-1))	DM05	73
	Y1=YA1(K-1) + DELTA*(YA1(K)-YA1(K-1))	DM05	74
	Y2=YA2(K-1) + DELTA*(YA2(K)-YA2(K-1))	DM05	75
30	YGAMN =Y1	DM05	76
	IF (EMACH,GT, 1.0) YGAMN =Y2	DM05	77
	GAMN=GAMN*F	DM05	78
	ZGAMN=ZGAMN*F	DM05	79
	GO TO 32	DM05	80
31	GAMN=0.0	DM05	81
32	CONTINUE	DM05	82
	IF (GAMN,NE,0.0) WRITE (6,702) XSA,GAMN,YGAMN,ZGAMN	DM05	83
	RETURN	DM05	84
	END	DM05	85

	SUBROUTINE BODYR(X,H,RPRIME)	DM06	1
C		DM06	2
C	VERSION: DEMON1	DM06	3
C		DM06	4
C	SUBROUTINE FOR THE CALCULATION OF BODY RADII AND SLOPE. THE INTEGER	DM06	5
C	VARIABLE HCODE CONTROLS THE TYPE OF NOSE DEFINITION	DM06	6
C	HCODE=0 PARABOLIC BODY	DM06	7
C	HCODE=1 SEARS-HAACK-ADAMS BODY	DM06	8
C	HCODE=2 TANGENT OGIVE	DM06	9
C	HCODE=3 ELLIPSOIDAL BODY	DM06	10
C	HCODE=4 CONICAL BODY	DM06	11
C		DM06	12
	COMMON/T=0/DU41(1214),HCODE,BETASH,B50,RADIUS,PFIELD,DUM3 ,U,V,VT,	DM06	13
	LNNOSE,DUM2(5),LBODY,NXBODY	DM06	14
C		DM06	15
	REAL LNNOSE,LBODY	DM06	16
	INTEGER HCODE	DM06	17
C		DM06	18
	IF(X,LE,LNNOSE) GO TO 20	DM06	19
C		DM06	20
C	CYLINDRICAL SECTION OF BODY	DM06	21
C		DM06	22
	R=RADIUS	DM06	23
	RPRIME=0.	DM06	24
	RETURN	DM06	25
C		DM06	26
C	NNOSE SECTION	DM06	27



C	20	XY=(LN0SE-X)/LN0SE	0406	24
		RR=RADIUS	0406	29
		IF(HCODE.GT.0)GO TO 22	0406	30
			0406	31
C			0406	32
C		PARABOLIC NOSE	0406	33
C			0406	34
		RE= RR*(1.-XX*XX)	0406	34
		RPRIME=RR/LN0SE*2.*XX	0406	36
		RETURN	0406	37
		22 GO TO(23,24,25,26),HCODE	0406	38
C			0406	39
C		SEARS=MAACK=ADAMS FOREBODY	0406	40
C			0406	41
		23 IF(XX.GT.9.999E-1) GO TO 223	0406	42
		XY=1.-XX*XX	0406	43
		PHI=XY*.75	0406	44
		RE= RR*PHI	0406	45
		RPRIME=RR/LN0SE*1.5*XX*PHI/XY	0406	46
		RETURN	0406	47
		223 R=0.0	0406	48
		RPRIME=1.59	0406	49
		RETURN	0406	50
C			0406	51
C		TANGENT OGIVE NOSE	0406	52
C			0406	53
		24 RL=RR/LN0SE	0406	54
		RDL=.5*(1.+RL*RL)/RL	0406	55
		XY=SQRT(RDL*RDL-XX*XX)	0406	56
		R=RADIUS-LN0SE*(RDL-XY)	0406	57
		RPRIME=XY/XY	0406	58
		RETURN	0406	59
C			0406	60
C		ELLIPSOID FOREBODY	0406	61
C			0406	62
		25 IF(XX.GT.9.999E-1) GO TO 223	0406	63
		PHI=SQRT(1.-XX*XX)	0406	64
		RE= RR*PHI	0406	65
		RPRIME=RR/LN0SE*XX/PHI	0406	66
		RETURN	0406	67
C			0406	68
C		CONE FOREBODY	0406	69
C			0406	70
		26 RE= RR*(1.-XX)	0406	71
		RPRIME=RR/LN0SE	0406	72
		RETURN	0406	73
		END	0406	74
		COMPLEX FUNCTION DBLU(Z)	0407	1
C			0407	2
C		VERSION: DEMON1	0407	3
C			0407	4
C		THIS FUNCTION SUBROUTINE CALCULATES THE INTERMEDIATE TRANSFORM	0407	5
C		VARIABLE = FOR THE CONFORMAL TRANSFORMATION OF AN ELLIPTICAL	0407	6
C		BODY WITH WINGS	0407	7
C			0407	8
		COMMON/COM1/A2,H2,R2	0407	9
		COMMON/COM3/ZR,ZI	0407	10
		COMMON/COM5/CNDZ	0407	11
		COMMON/COM6/A2,A	0407	12

C	COMPLEX Z,ZZ,D*ZZ,W,W2,WW	DM07	13
C	ZZ=Z*Z	DM07	14
	ZR=REAL(Z)	DM07	15
	ZI=AIMAG(Z)	DM07	16
	IF(ZR.NE.0.0) ZR=ZR/ABS(ZR)	DM07	17
	IF(ZI.NE.0.0) ZI=ZI/ABS(ZI)	DM07	18
	ZZ=ZZ+Z2+H2	DM07	19
	Y=AIMAG(ZZ)	DM07	20
	AY=1.0	DM07	21
	IF(Y.LT.0.0) AY=-1.0	DM07	22
	AYZ=1.0	DM07	23
	IF(ZI.LT.0.0) AYZ=-1.0	DM07	24
	ZZ=CSGRT(ZZ)*AY*AYZ	DM07	25
	IF((ABS(ZI).LE.0.0).AND.(REAL(Z).LT.0.0)) ZZ=CMPLX(-REAL(ZZ),	DM07	26
	AIMAG(ZZ))	DM07	27
	D*ZZ=0.5*(1.0+Z/ZZ)	DM07	28
	W=0.5*(Z+ZZ)	DM07	29
	W2=1.0/W*W	DM07	30
	DBLU=WW	DM07	31
	RETURN	DM07	32
	END	DM07	33

	SUBROUTINE DOUHLT(J)	DM08	1
C		DM08	2
C	VERSION1 DEMON1	DM08	3
C		DM08	4
C	SUBROUTINE TO CALCULATE THE VELOCITIES DUE TO A LINEAR LINE DOUBLET OF	DM08	5
C	UNIT STRENGTH WITH ORIGIN AT TX(J).	DM08	6
C		DM08	7
	INTEGER MCODE	DM08	8
	COMMON/T,M,TX(101),DUM1(505),ZZ(403),T(100),TC(100),COEFF(5),	DM08	9
	IRCODE,RETASQ,BSQ,RADIUS,RFIELD,RNUSE,U,V,VT,XA,XC,XD,BETA,XFIELD,	DM08	10
	ZX2,XH,NXBODY	DM08	11
C		DM08	12
	100 FORMAT(140,50HFIELD POINT IS WITHIN TAIL MACH CONE. U AND V SET TO	DM08	13
	10 ZERO.)	DM08	14
C		DM08	15
C		DM08	16
C		DM08	17
C	IN THE FOLLOWING, U AND V SHOULD HAVE FACTOR COS(THPLPH) FACTOR IN	DM08	18
C	FRONT.	DM08	19
C	VT SHOULD HAVE FACTOR SIN(THPLPH) FACTOR IN FRONT.	DM08	20
C	ANGLE THPLPH IS MEASURED CLOCKWISE FROM THE LEeward DIRECTION WHEN	DM08	21
C	VIEwed FROM THE REAR.	DM08	22
C	THE ANGULAR DEPENDENCE ON ANGLE THPLPH IS ACCOUNTED FOR IN	DM08	23
C	SUBROUTINE VELCAL.	DM08	24
	X1=XFIELD-TX(J)	DM08	25
	HR=BETA*RFIELD	DM08	26
	IF(X1.LE.HR) GO TO 10	DM08	27
	IF(X2.LE.HR) GO TO 21	DM08	28
	WRITE(6,100)	DM08	29
	GO TO 10	DM08	30
21	XHR=X1/HR	DM08	31
	XX=SQRT(XHR*XHR-1.)	DM08	32
	U=BETA*XX	DM08	33
	ACOSH=ALOG(XHR+XX)	DM08	34
	V=XHR*XX	DM08	35

VE=.5*HETASQ*(ACOSH+XX)	DM08	36
VT=.5*HETASQ*(ACOSH+XX)	DM08	37
RETURN	DM08	38
C FIELD POINT IS AHEAD OF MACH CONE FROM DOUBLET ORIGIN.	DM08	39
C	DM08	40
10 U=0.	DM08	41
V=0.	DM08	42
VT=0.	DM08	43
RETURN	DM08	44
END	DM08	45
	DM08	46
COMPLEX FUNCTION DSDZ(S)	DM09	1
C	DM09	2
C VERSION: DEMON1	DM09	3
C	DM09	4
COMMON/COM2/SIG2,M2	DM09	5
COMMON/COM5/DWDZ	DM09	6
COMMON/COM4/G2,G1	DM09	7
COMMON/COM6/*2,K	DM09	8
COMPLEX W,M2,DWDZ,G1,G2	DM09	9
DSDZ=0.5*(1.0-SIG2*M2)*(1.0+G1/G2)*DWDZ	DM09	10
RETURN	DM09	11
END	DM09	12
SUBROUTINE EDGES(MS*P,SPAN,RBOD,ANGLE,ANGTE,Y,SWLE,SWTE)	DM10	1
C	DM10	2
C VERSION: DEMON1	DM10	3
C	DM10	4
THIS ROUTINE CALCULATES EQUALLY SPACED SIDE-EDGES.	DM10	5
SWEEP ANGLE ARRAYS ARE SET EQUAL TO CONSTANT	DM10	6
LEADING EDGE AND TRAILING EDGE VALUES.	DM10	7
C	DM10	8
DIMENSION Y(1),SWLE(1),SWTE(1)	DM10	9
C	DM10	10
OYP=SPAN/(MS*P-1)	DM10	11
DO 50 I=1,MS*P	DM10	12
AI=I-1	DM10	13
SWLE(I)=ANGLE	DM10	14
SWTE(I)=ANGTE	DM10	15
Y(I)=OYP*AI+RBOD	DM10	16
50 CONTINUE	DM10	17
SWLE(1)=0.0	DM10	18
SWTE(1)=0.0	DM10	19
C	DM10	20
RETURN	DM10	21
END	DM10	22
SUBROUTINE EDGVOR	DM11	1
C	DM11	2
C VERSION: DEMON1	DM11	3
C	DM11	4
COMPUTE EFFECTS AT CONTROL POINTS ON FINS AND BODY INTERFERENCE	DM11	5
SHELL OF FIN LEADING AND SIDE EDGE VORTICITY.	DM11	6
C	DM11	7

C		DM11	7
	LOGICAL BODY	DM11	8
C		DM11	9
	COMMON/ONE/CIRC(250),DELTP(250),FN(250),PNLC(250),SWPPLE(250),	DM11	10
	1S+PPTF(250),VNDR(250),XBAR(250),ZBAR(250),XCPT(250),YCPT(250),ZCPT(250),	DM11	11
	2(250),XLF(250),XLH(250),XRF(250),XRH(250),YLC(250),YHC(250),ZLF(250),	DM11	12
	30),ZRF(250),ZLB(250),ZRB(250),SHT(125),CST(125),SHT2(125),CST2(125),	DM11	13
	4),IP(300),XFHIP(100),A,ALFA,ALFR,ARWING,R2,R2V,RETA,BETAR,CONST,	DM11	14
	SCOSALF,COSHET,CM,DX,EY,FHACH,RCIR,SINALF,SINRET,SLOPE,TLRAC,TIPY,	DM11	15
	6TGLR,U,V,W,UCHK,VCHK,WCHK,WBIP,X,Y,Z,I,TF,II,J,MSWR,MSWL,MSWL,	DM11	16
	7MSWD,ARIP,ACRX,NCW,NDRAG,NRP,NRP,NRP,N3P,NDCPT,NOLINP,NOUT,NPANELS,	DM11	17
	ANPRESS,NWBP,ASYM,BODY,DELTAS,MOSYM	DM11	18
	COMMON/VRTXV/VVRTX(150),WVRTX(150),NVRTPI,NVRTX,VRTMAX	DM11	19
	COMMON/HVEL/HOU(150),RDV(150),RDW(150),XFLOP(150),YFLOP(150),	DM11	20
	1 ZFLOP(150)	DM11	21
	COMMON/FINLE/XLE(80),CGLOC(80),GAMLE(80),FKLE,NEDGV,MLEVR,MLEVL,	DM11	22
	1 MLEVV,MLEVD	DM11	23
	COMMON/FINSE/XSE(80),COSELC(80),GAMSE(80),FKSE,MSIDGE,NSEV	DM11	24
	COMMON/VORSPC/GAMMA(10),YVRTX(10),ZVRTX(10),PLOC	DM11	25
	COMMON/ELLIPS/RA,RH,ERATIO	DM11	26
C		DM11	27
	DATA PI/3,141592653589/	DM11	28
C		DM11	29
	716 FORMAT (1H1,15X,43HFIN L.E. AND S.E. EFFECTS AT CONTROL POINTS//	DM11	30
	1 2X,1HX,5X,4HX,CP,7X,4HY,CP,7X,4HZ,CP,6X,4HGGAMMA/,6X,7HY,VRTX/,4X,	DM11	31
	2 7HZ,VRTX/,3X,6HV,VRTX,5X,6HW,VRTX/34X,11H2PI*RR*VIN/,2X,2HRRB,9X,	DM11	32
	3 2HRR/)	DM11	33
	717 FORMAT (1X,I3,8(1X,F10,5))	DM11	34
C		DM11	35
C		DM11	36
C	EFFECT OF FIN L.E. VORTICITY AT THE FIN CONTROL POINTS AND THE	DM11	37
C	BODY INTERFERENCE PANEL CONTROL POINTS.	DM11	38
C		DM11	39
	NDCPT=1	DM11	40
	NVWTE=NVRTX	DM11	41
	IF (NOUT.EQ.0) WRITE (6,716)	DM11	42
	JTIPLE=NRP+NCW+1	DM11	43
	XTIPLE=XRF(JTIPLE)	DM11	44
	DENOM=2.0*PI*RH	DM11	45
	JTIPT=NRP	DM11	46
	XTIPT=XRH(JTIPT)	DM11	47
	DO 33 K=1,NWBP	DM11	48
	XFLOP(K)=XCPT(K)	DM11	49
	YFLOP(K)=YCPT(K)	DM11	50
	ZFLOP(K)=ZCPT(K)	DM11	51
	IF (NEDGV.EQ.0) GO TO 34	DM11	52
	IFIN=1	DM11	53
	KSTART=1	DM11	54
	KUL=MLEVR	DM11	55
55	CONTINUE	DM11	56
	IF (IFIN.EQ.5) GO TO 34	DM11	57
	IF (IFIN.EQ.2) KSTART=MLEVR+1	DM11	58
	IF (IFIN.EQ.3) KSTART=MLEVR+MLEVL+1	DM11	59
	IF (IFIN.EQ.4) KSTART=MLEVR+MLEVL+MLEVV+1	DM11	60
	DO 36 IFV=KSTART,KUL	DM11	61
	IF (XCPT(K).LT.XLE(KSTART)) GO TO 34	DM11	62
	JV=IFV+1	DM11	63
	IF (IFV.EQ.1) JV=1	DM11	64
	IF (XCPT(K).LE.XLE(IFV)) GO TO 37	DM11	65
36	CONTINUE	DM11	66
	IF (XCPT(K).LE.XTIPLE) GO TO 38	DM11	67
	GO TO 34	DM11	68
37	KV=JV+1	DM11	69

x1=x1E(JV)	DM11	70
x2=x1E(KV)	DM11	71
DIFF=x2-x1	DM11	72
w1=(x2-xcpt(k))/DIFF	DM11	73
w2=(xcpt(k)-x1)/DIFF	DM11	74
IF (IFIN.EQ.3.OR.IFIN.EQ.4) GO TO 39	DM11	75
YVINT=w1*CGLOC(JV)+w2*CGLOC(KV)	DM11	76
ZVBAR=xcpt(k)*TAN(ALFR/2.0)	DM11	77
GAMINT=w1*GAMLE(JV)+w2*GAMLE(KV)	DM11	78
YVRTX(1)=YVINT/RH	DM11	79
ZVRTX(1)=ZVBAR/RH	DM11	80
GAMMA(1)=GAMINT/DENOM	DM11	81
GO TO 31	DM11	82
38 GAMMA(1)=GAMLE(KUL)/DENOM	DM11	83
GAMINT=GAMLE(KUL)	DM11	84
IF (IFIN.EQ.3.OR.IFIN.EQ.4) GO TO 32	DM11	85
YVRTX(1)=CGLOC(KUL)/RH	DM11	86
ZVRTX(1)=xcpt(k)*TAN(ALFR/2.0)/RH	DM11	87
YVINT=CGLOC(KUL)	DM11	88
ZVBAR=ZVRTX(1)*RH	DM11	89
GO TO 31	DM11	90
32 YVRTX(1)=xcpt(k)*TAN(BETAR)/RH	DM11	91
ZVRTX(1)=CGLOC(KUL)/RH	DM11	92
YVINT=YVRTX(1)*RH	DM11	93
ZVBAR=CGLOC(KUL)	DM11	94
31 RLOC=RH	DM11	95
NVRTX=1	DM11	96
IF (HDDY.AND.RA.EQ.RH) CALL VORTEX (K,K)	DM11	97
YCP=YFLDP(K)	DM11	98
ZCP=ZFLDP(K)	DM11	99
THETP=ATAN2(ZCP,YCP)	DM11	100
SINTH=SIN(THETP)	DM11	101
COSTH=COS(THETP)	DM11	102
RCPT=SQRT(YCP*YCP+ZCP*ZCP)	DM11	103
RBODY=SQRT(1.0/((SINTH/RA)**2+(COSTH/RH)**2))	DM11	104
IF (RCPT.LE.RBODY) GO TO 20	DM11	105
GO TO 21	DM11	106
20 YCP=1.01*RBODY*COSTH	DM11	107
ZCP=1.01*RBODY*SINTH	DM11	108
21 CONTINUE	DM11	109
IF (HDDY.AND.RA.NE.RH) CALL VVELS(1,YCP,ZCP,YVINT,ZVBAR,	DM11	110
1 GAMINT,RH,RA,YVRTX(K),NVRTX(K),VINT*AX)	DM11	111
IF (NOUT.NE.0) WRITE (6,717) K,YFLDP(K),YFLDP(K),ZFLDP(K),	DM11	112
1 GAMMA(1),YVRTX(1),ZVRTX(1),YVRTX(K),NVRTX(K)	DM11	113
GO TO 40	DM11	114
39 ZVINT=w1*CGLOC(JV)+w2*CGLOC(KV)	DM11	115
YVBAR=xcpt(k)*TAN(BETAR/2.0)	DM11	116
GAMINT=w1*GAMLE(JV)+w2*GAMLE(KV)	DM11	117
YVRTX(1)=YVBAR/RH	DM11	118
ZVRTX(1)=ZVINT/RH	DM11	119
GAMMA(1)=GAMINT/DENOM	DM11	120
RLOC=RH	DM11	121
NVRTX=1	DM11	122
IF (HDDY.AND.RA.EQ.RH) CALL VORTEX (K,K)	DM11	123
YCP=YFLDP(K)	DM11	124
ZCP=ZFLDP(K)	DM11	125
THETP=ATAN2(ZCP,YCP)	DM11	126
SINTH=SIN(THETP)	DM11	127
COSTH=COS(THETP)	DM11	128
RCPT=SQRT(YCP*YCP+ZCP*ZCP)	DM11	129
RBODY=SQRT(1.0/((SINTH/RA)**2+(COSTH/RH)**2))	DM11	130
IF (RCPT.LE.RBODY) GO TO 22	DM11	131
GO TO 23	DM11	132

22	YCP=1.01*RHODY*COSTH	DM11	133
	ZCP=1.01*RHODY*SINTH	DM11	134
23	CONTINUE	DM11	135
	IF (BODY.AND.RA.NE.RB) CALL VVELS(1,YCP,ZCP,YVHAR,ZVINT,	DM11	136
	1 GAMINT,RR,RA,VVRTX(K1),VVRTX(K),VRTMAX)	DM11	137
	IF (NOUT.NE.0) WRITE (6,717) K,XFLDP(K),YFLDP(K),ZFLDP(K),	DM11	138
	1 GAMMA(1),VVRTX(1),ZVRTX(1),VVHIX(K),VVRTX(K1)	DM11	139
40	CONTINUE	DM11	140
	IFIN=IFIN+1	DM11	141
	IF (IFIN.EQ.2) KUL=MLEVR+MLEVL	DM11	142
	IF (IFIN.EQ.3) KUL=MLEVR+MLEVL+MLEVD	DM11	143
	IF (NCPX.EQ.0) GO TO 34	DM11	144
	IF (IFIN.EQ.4) KUL=MLEVR+MLEVL+MLEVD+MLEVO	DM11	145
	GO TO 34	DM11	146
34	CONTINUE	DM11	147
C		DM11	148
C	EFFECTS OF FIN S.E. VORTICITY AT FIN CONTROL PRINTS AND BODY	DM11	149
C	INTERFERENCE PANELS.	DM11	150
C		DM11	151
	IF (NSIDG.EQ.0) GO TO 48	DM11	152
	IFIN=1	DM11	153
	KSTART=1	DM11	154
	KUL=NSEV	DM11	155
47	CONTINUE	DM11	156
	IF (IFIN.EQ.5) GO TO 48	DM11	157
	IF (IFIN.EQ.2) KSTART=NSEV+1	DM11	158
	IF (IFIN.EQ.3) KSTART=2*NSEV+1	DM11	159
	IF (IFIN.EQ.4) KSTART=3*NSEV+1	DM11	160
	DO 49 JSE=KSTART,KUL	DM11	161
	IF (XCPT(K).LT.XSE(KSTART)) GO TO 48	DM11	162
	JVSE=JSE-1	DM11	163
	IF (JSE.EQ.1) JVSE=1	DM11	164
	IF (XCPT(K).LE.XSE(JVSE)) GO TO 46	DM11	165
49	CONTINUE	DM11	166
	IF (XCPT(K).LE.XTIPT) GO TO 41	DM11	167
	GO TO 48	DM11	168
46	CONTINUE	DM11	169
	KVSE=JVSE+1	DM11	170
	X1=XSE(JVSE)	DM11	171
	X2=XSE(KVSE)	DM11	172
	DIFF=X2-X1	DM11	173
	WT1=(X2-XCPT(K))/DIFF	DM11	174
	WT2=(XCPT(K)-X1)/DIFF	DM11	175
	IF (IFIN.EQ.3.OR.IFIN.EQ.4) GO TO 45	DM11	176
	VVINT=WT1*CGSELC(JVSE)+WT2*CGSELC(KVSE)	DM11	177
	ZVHAR=XCPT(K)*TAN(ALFR/2.0)		
	GAMINT=WT1*GAMSE(JVSE)+WT2*GAMSE(KVSE)	DM11	178
	VVRTX(1)=VVINT/RB	DM11	179
	ZVRTX(1)=ZVHAR/RB	DM11	180
	GAMMA(1)=GAMINT/GENUM	DM11	181
	GO TO 42	DM11	182
41	GAMMA(1)=GAMSE(KUL)/DENOM	DM11	183
	GAMINT=GAMSE(KUL)	DM11	184
	IF (IFIN.EQ.3.OR.IFIN.EQ.4) GO TO 43	DM11	185
	VVRTX(1)=CGSELC(KUL)/RB	DM11	186
	ZVRTX(1)=XCPT(K)*TAN(ALFR/2.0)/RB	DM11	187
	VVINT=CGSELC(KUL)	DM11	188
	ZVHAR=ZVRTX(1)*RB	DM11	189
	GO TO 42	DM11	190
43	VVRTX(1)=(-XCPT(K)*TAN(METAR/2.0))/RB	DM11	191
	ZVRTX(1)=CGSELC(KUL)/RB	DM11	192
	VVINT=VVRTX(1)*RB	DM11	193
	ZVHAR=CGSELC(KUL)	DM11	194
		DM11	195

42	RLOC=RB	DM11	196
	NVRTX=1	DM11	197
	IF (BODY.AND.RA.EQ.RB) CALL VORTEX (K,K)	DM11	198
	IF (BODY.AND.RA.NE.RB) CALL VVELS(1,YFLDP(K),ZFLDP(K),YVINT,ZVBAR,DM11	DM11	199
	1 GAMINT,RR,RA,VVRTX(K),*VRTX(K),VRTMAX)	DM11	200
	IF (NOUT.NE.0) WRITE (6,717) K,XFLDP(K),YFLDP(K),ZFLDP(K),	DM11	201
	1 GAMMA(1),YVRTX(1),ZVRTX(1),VVRTX(K),*VRTX(K)	DM11	202
	GO TO 44	DM11	203
45	ZVINT=WT1*CGSELC(JVSE)+WT2*CGSELC(KVSE)	DM11	204
	YVBAR=XOPT(K)*TAN(HEBAR/2.0)	DM11	205
	GAMINT=WT1*GAMSE(JVSE)+WT2*GAMSE(KVSE)	DM11	206
	YVRTX(1)=YVBAR/RR	DM11	207
	ZVRTX(1)=ZVINT/RR	DM11	208
	GAMMA(1)=GAMINT/DENUM	DM11	209
	RLOC=RB	DM11	210
	NVRTX=1	DM11	211
	IF (BODY.AND.RA.EQ.RB) CALL VORTEX (K,K)	DM11	212
	IF (BODY.AND.RA.NE.RB) CALL VVELS(1,YFLDP(K),ZFLDP(K),YVBAR,ZVINT,DM11	DM11	213
	1 GAMINT,RR,RA,VVRTX(K),*VRTX(K),VRTMAX)	DM11	214
	IF (NOUT.NE.0) WRITE (6,717) K,XFLDP(K),YFLDP(K),ZFLDP(K),	DM11	215
	1 GAMMA(1),YVRTX(1),ZVRTX(1),VVRTX(K),*VRTX(K)	DM11	216
44	CONTINUE	DM11	217
	IFIN=IFIN+1	DM11	218
	IF (IFIN.EQ.2) KUL=2*NSEV	DM11	219
	IF (IFIN.EQ.3) KUL=3*NSEV	DM11	220
	IF (NCRX.EQ.0) GO TO 48	DM11	221
	IF (IFIN.EQ.4) KUL=4*NSEV	DM11	222
	GO TO 47	DM11	223
48	CONTINUE	DM11	224
33	CONTINUE	DM11	225
	NVRTX=NVRT	DM11	226
	RETURN	DM11	227
	END	DM11	228

	SUBROUTINE LAYOUT (SLPWLE,SLPWTE,Y,*SWP,CRP,NS,CTP,RHI,THET)	DM12	1
C		DM12	2
C	VERSION: DEMON2	DM12	3
C		DM12	4
C	THIS SUBROUTINE LAYS OUT AND DETERMINES GEOMETRICAL PROPERTIES	DM12	5
C	OF THE CONSTANT U-VELOCITY PANELS ON THE WING OR FIN SURFACES	DM12	6
C	AND ON THE BODY OR FUSELAGE WHERE MUTUAL WING-BODY INTERFERENCE	DM12	7
C	OCCURS.	DM12	8
C		DM12	9
	DIMENSION CSIDE(20),NPD(3),Y(1)	DM12	10
C		DM12	11
	LOGICAL LEFT,ASYM,BODY,DELTA,TRUSYM,NOSYM	DM12	12
C		DM12	13
	COMMON/ONE/CIRC(250),DELTP(250),FN(250),PNLC(250),SWPPL(250),	DM12	14
	1SWPTE(250),VNDH(250),XBAR(250),ZBAR(250),XOPT(250),YOPT(250),ZOPT	DM12	15
	2(250),XLF(250),XLH(250),XRF(250),XRR(250),YLC(250),YRC(250),ZLF(250)	DM12	16
	30),ZRF(250),ZLH(250),ZRR(250),SNT(125),CST(125),SNT2(125),CST2(125)	DM12	17
	4),IP(300),XFRIP(100),A,ALFA,ALFR,AMWING,R2,R2V,ETA,HTAP,CONST,	DM12	18
	5COSALF,COSBET,CY,DX,EM,FMACH,RCIR,SINALF,SINBET,SLOPE,TLRNC,TTY,	DM12	19
	6TUTLR,U,V,*UCHK,VCHK,WCHK,WBIP,X,DUMY,Z,IV,TF,II,JV,MSWR,MSWL,	DM12	20
	7MSWU,MSWD,NEIP,NCRX,NCK,NDRAG,NHP,NRH,NRP,N3P,NOCPT,NOLIP,NOUT,	DM12	21
	8NPANLS,NPRESS,NWBP,ASVM,BODY,DELTA,NOSYM	DM12	22
	COMMON/SWEEPS/VSWLER(20),VSWTER(20),VSWLEL(20),VSWTEL(20),	DM12	23
	1 VSWLEU(20),VSWTEU(20),VSWLED(20),VSWTED(20),LVSWP,LEFT,FAC,NCHB	DM12	24
	2,ARPUL(250),*IDTH(250)	DM12	25

COMMON/VRTXV/DIMMY(301),NVRTX,VRTMAX	DM12	26
COMMON/WBTR/THET(125),X*LE	DM12	27
COMMON /ELLIPS/ RA,RA,ERATIO	DM12	28
COMMON /INTROT/ PHIDIN,THETIT,YHOD,ZHOD,PHIFR,PHIFU	DM12	29
C	DM12	30
C	DM12	31
DATA PI/3,1415926535897/	DM12	32
C	DM12	33
C FUNCTION DEFINING THE RADIUS OF AN ELLIPSE IN TERMS OF THET	DM12	34
C	DM12	35
FRAD(SN,CS)=1.0/SQRT((CS/RA)**2+(SN/RA)**2)	DM12	36
FYROT(YP) = COSINE*YP+YHOD	DM12	37
FZROT(YP) = SINE *YP+ZHOD	DM12	38
C	DM12	39
TRUSYM=BETAR.EQ.0.0.AND..NOT.DELTA	DM12	40
DTOR = PI/180.	DM12	41
C	DM12	42
C NS(=IL+1) IS WING QUADRANT INDICATOR	DM12	43
C NS=1, RIGHT FIN# =2, LEFT FIN# =3, UPPER FIN# =4, LOWER FIN	DM12	44
C NS=5, BODY	DM12	45
C REFER TO MAIN PROGRAM CRFWBD FOR CORRESPONDENCE BETWEEN FINS ON	DM12	46
C CRUCIFORM AND INTERDIGITATED CONFIGURATIONS.	DM12	47
C	DM12	48
IF (NS.EQ.5) GO TO 200	DM12	49
LEFT = NS.EQ.2 .OR. NS.EQ.4	DM12	50
ANCW=NCW	DM12	51
SLPCIF= SLP*LE=SLP*TE	DM12	52
CSIDE(1)= CRP	DM12	53
NPD(1)=NPP	DM12	54
NPD(2)=NMP	DM12	55
NPD(3)=N3P	DM12	56
C	DM12	57
C VERTICAL WING TREATED IN THE SAME WAY AS HORIZONTAL WING	DM12	58
C Y AND Z COORDINATES ARE INTERCHANGED FOR VERTICAL WING	DM12	59
C	DM12	60
C LEFT STANDS FOR EITHER LEFT HORIZONTAL WING OR FOR LOWER	DM12	61
C VERTICAL WING	DM12	62
C	DM12	63
C LOCATE (Y,Z) OF WING BODY JUNCTION	DM12	64
C	DM12	65
IF (THET.EQ.90.0) GO TO 100	DM12	66
GO TO 101	DM12	67
100 CS=0.0	DM12	68
SN=1.0	DM12	69
GO TO 104	DM12	70
101 CONTINUE	DM12	71
CS = COS(THET*DTOR)	DM12	72
SN = SIN(THET*DTOR)	DM12	73
104 CONTINUE	DM12	74
RAD = FRAD(SN,CS)	DM12	75
IF (LEFT) RAD=-RAD	DM12	76
YHOD = RAD*CS	DM12	77
ZHOD = RAD*SN	DM12	78
C	DM12	79
C	DM12	80
C DEFINE DIHEDRAL ANGLES OF FINS	DM12	81
C	DM12	82
IF (PHI.EQ.90.0) GO TO 102	DM12	83
GO TO 103	DM12	84
102 COSINE=0.0	DM12	85
SINE=1.0	DM12	86
GO TO 105	DM12	87
103 CONTINUE	DM12	88



	COSINE = COS(PHI*DTOR)	DM12 89
	SINE = SIN(PHI*DTOR)	DM12 90
105	CONTINUE	DM12 91
C		DM12 92
C	INDEX I RUNS SPANWISE, * CHORDWISE ALONG WING	DM12 93
C	CALCULATE LENGTHS OF OUTBOARD PANEL SIDE, CSIDE	DM12 94
C	J IS THE PANEL NUMBER	DM12 95
C		DM12 96
	WLEX=0.0	DM12 97
	DO 140 I=2, NSWP	DM12 98
	IM=I-1	DM12 99
C		DM12 100
C	LVSWP: VARIABLE WING SWEEP OPTION	DM12 101
C	LVSWP=0, GENERATE Y INTERNALLY IN CREW	DM12 102
C	LVSWP=1, READ IN Y+S,	DM12 103
C		DM12 104
	IF (LVSWP, 0.0) GO TO 40	DM12 105
	GO TO (42, 41, 30, 31), NS	DM12 106
C		DM12 107
C	CASE FOR YANED WING, STREAMWISE PLANE PASSING THROUGH ROOTCHORD	DM12 108
C	LE INTERSECTS WING TE	DM12 109
C	TE SWEEPS MAY VARY AS A CONSEQUENCE	DM12 110
C		DM12 111
C	PANELS ON RIGHT HAND WING	DM12 112
		DM12 113
42	SLPWLE= TAN(VSWLER(I)*DTOR)	DM12 114
	SLPWTE= TAN(VSWTER(I)*DTOR)	DM12 115
	GO TO 44	DM12 116
C		DM12 117
C	PANELS ON LEFT HAND WING	DM12 118
C		DM12 119
41	SLPWLE= TAN(=VSWLEL(I)*DTOR)	DM12 120
	SLPWTE= TAN(=VSWTEL(I)*DTOR)	DM12 121
	GO TO 44	DM12 122
C		DM12 123
C	PANELS ON UPPER WING	DM12 124
		DM12 125
30	SLPWLE= TAN(VSWLEU(I)*DTOR)	DM12 126
	SLPWTE= TAN(VSWTEU(I)*DTOR)	DM12 127
	GO TO 44	DM12 128
C		DM12 129
C	PANELS ON LOWER WING	DM12 130
C		DM12 131
31	SLPWLE= TAN(=VSWLED(I)*DTOR)	DM12 132
	SLPWTE= TAN(=VSWTED(I)*DTOR)	DM12 133
C		DM12 134
C		DM12 135
44	SLPDIF= SLPWLE-SLPWTE	DM12 136
	CSIDE(I)= CSIDE(IM)-(Y(I)-Y(IM))*SLPDIF	DM12 137
	IF (LEFT) CSIDE(I)= CSIDE(IM)+(Y(I)-Y(IM))*SLPDIF	DM12 138
	GO TO 43	DM12 139
C		DM12 140
C	NONVARYING L.E. AND T.E. SWEEPS CONSTANT VALUES USED	DM12 141
C		DM12 142
40	CSIDE(I)= CRP+(Y(I)-Y(1))*SLPDIF	DM12 143
	IF (LEFT) CSIDE(I)= CRP+(Y(I)-Y(1))*SLPDIF	DM12 144
43	CONTINUE	DM12 145
C		DM12 146
C	SWPPLE AND SWPTE ARE PANEL L.E. AND T.E. SWEEPS	DM12 147
C	CALCULATE PANEL CORNER POINT COORDINATES	DM12 148
C		DM12 149
	IF (I.EQ.2) GO TO 45	DM12 150
	ILE=(I-3)*NC+1	DM12 151

IF (NS.GT.1) JLE=JLE+NPD(NS=1)	DM12 152
WLEX=XRF(JLE)	DM12 153
IF (LEFT) WLEX=XLF(JLE)	DM12 154
45 CONTINUE	DM12 155
C	DM12 156
DO 130 K=1,NCW	DM12 157
J=(I-2)*NC+K	DM12 158
IF (NS.GT.1) J=J+NPD(NS=1)	DM12 159
AKMK=1	DM12 160
AKSK	DM12 161
S*PPLF(J)=SLP*LE=AKM*SLPDIF/ANCW	DM12 162
S*PPTE(J)=SLP*LE=AK*SLPDIF/ANCW	DM12 163
IF (ABS(S*PPLF(J)).LE.0.001) S*PPLF(J)=0.0	DM12 164
IF (ABS(S*PPTE(J)).LE.0.001) S*PPTE(J)=0.0	DM12 165
IF (LEFT) GO TO 50	DM12 166
C	DM12 167
C PANEL LAY OUT FOR RIGHT RIGHT HAND WING CORNER POINTS.	DM12 168
C THEY APPLY TO RIGHT AND UPPER FINS.	DM12 169
C	DM12 170
XLF(J)=AKM*CSIDE(IM)/ANCW+WLEX	DM12 171
XLH(J)=XLF(J)+CSIDE(IM)/ANCW	DM12 172
XRF(J)=AKM*CSIDE(I)/ANCW+(Y(I)-Y(IM))*SLP*LE+WLEX	DM12 173
XRB(J)=XRF(J)+CSIDE(I)/ANCW	DM12 174
YLC(J)=Y(IM)	DM12 175
YRC(J)=Y(I)	DM12 176
GO TO 51	DM12 177
C	DM12 178
C PANEL LAY OUT FOR LEFT HAND WING CORNER POINTS.	DM12 179
C THEY APPLY TO LEFT AND LOWER FINS.	DM12 180
C	DM12 181
50 CONTINUE	DM12 182
XLF(J)=AKM*CSIDE(I)/ANCW+(Y(I)-Y(IM))*SLP*LE+WLEX	DM12 183
XRF(J)=AKM*CSIDE(IM)/ANCW+WLEX	DM12 184
XRB(J)=XRF(J)+CSIDE(IM)/ANCW	DM12 185
XLH(J)=XLF(J)+CSIDE(I)/ANCW	DM12 186
YLC(J)=Y(I)	DM12 187
YRC(J)=Y(IM)	DM12 188
51 CONTINUE	DM12 189
ZLF(J)=0.0	DM12 190
ZRF(J)=0.0	DM12 191
ZLH(J)=0.0	DM12 192
ZRH(J)=0.0	DM12 193
C	DM12 194
C FIND Y-COORDINATE OF CONTROL POINT AND PANEL CENTROID	DM12 195
C	DM12 196
A1=XRB(J)-XRF(J)	DM12 197
A2=XLH(J)-XLF(J)	DM12 198
H=Y(I)-Y(IM)	DM12 199
YBAR=(2.0*A1+A2)*H/(3.0*(A1+A2))	DM12 200
YCPT(J)=Y(IM)+YBAR	DM12 201
IF (LEFT) YBAR=(2.0*A2+A1)*H/(3.0*(A1+A2))	DM12 202
IF (LEFT) YCPT(J)=Y(IM)-YBAR	DM12 203
C	DM12 204
C FIND X-COORDINATE OF CONTROL POINT AND PANEL CENTROID	DM12 205
C	DM12 206
XPCLE=XLF(J)+YBAR*S*PPLF(J)	DM12 207
XPCTE=XLH(J)+YBAR*S*PPTE(J)	DM12 208
IF (LEFT) XPCLE=XRF(J)+YBAR*S*PPLF(J)	DM12 209
IF (LEFT) XPCTE=XRB(J)+YBAR*S*PPTE(J)	DM12 210
P*LC(J)=XPCTE-XPCLE	DM12 211
XCPT(J)=XPCLE+FAC*P*LC(J)	DM12 212
XHAP(J)=(XPCTE+XPCLE)/2.0	DM12 213
C	DM12 214

C	ZCPT(J)=0.0	DM12 215
C	ZHAP(J)=0.0	DM12 216
C	IF (.NOT.LEFT) GO TO 120	DM12 217
C	IF (SWPPLE(J),FN,0.0) SWPPLE(J)=TLRNC	DM12 218
C	IF (SWPPTL(J),FR,0.0) SWPPTL(J)=TLRNC	DM12 219
C	SWPPLE(J)=-SWPPLE(J)	DM12 220
C	SWPPTL(J)=-SWPPTL(J)	DM12 221
C	120 CONTINUE	DM12 222
C		DM12 223
C	AREA AND WIDTH OF PANEL IN LOCAL COORDINATES	DM12 224
C		DM12 225
C	121 ARPNL(J)=0.5*(YRC(J)-YLC(J))*(XLB(J)-XLF(J)+XRB(J)-XRF(J))	DM12 226
C	WIDTH(J)=YRC(J)-YLC(J)	DM12 227
C		DM12 228
C	TRANSFORM FROM FIN COORDINATES TO THE WING REFERENCE COORDINATE	DM12 229
C	SYSTEM XW,YW,ZW.	DM12 230
C		DM12 231
C	ZLF(J) = FZROT(YLC(J)-Y(1))	DM12 232
C	ZLH(J) = ZLF(J)	DM12 233
C	YLC(J) = FYROT(YLC(J)-Y(1))	DM12 234
C	ZPF(J) = FZROT(YRC(J)-Y(1))	DM12 235
C	ZPR(J) = ZRF(J)	DM12 236
C	YRC(J) = FYROT(YRC(J)-Y(1))	DM12 237
C	ZBAR(J) = FZROT(YCPT(J)-Y(1))	DM12 238
C	ZCPT(J) = ZBAR(J)	DM12 239
C	YCPT(J) = FYROT(YCPT(J)-Y(1))	DM12 240
C	130 CONTINUE	DM12 241
C	140 CONTINUE	DM12 242
C	CTP=CSIDE(MSWP)	DM12 243
C	RETURN	DM12 244
C		DM12 245
C	***** LAY OUT BODY INTERFERENCE PANELS *****	DM12 246
C		DM12 247
C	200 DX=CRP/NCWB	DM12 248
C		DM12 249
C		DM12 250
C	NOTE: MSWP IS ACTUALLY MBDCR	DM12 251
C		DM12 252
C	MSWP = 4*(MSWP/4)	DM12 253
C	MS90 = MSWP/4	DM12 254
C	MS180 = 2*MS90	DM12 255
C	MS270 = 3*MS90	DM12 256
C	MMSWP = MSWP	DM12 257
C	IF (TRUSV) MMSWP=MMSWP/2	DM12 258
C	DTHTOG = 90./FLOAT(MS90)	DM12 259
C	DTHTS = DTHTOG	DM12 260
C	DTHTU = DTHTOG	DM12 261
C		DM12 262
C	IT1,IT2,IT3,IT4,...,INDEX OF INTERFERENCE PANEL IMMEDIATELY	DM12 263
C	PRECEDING FIN LOCATIONS ON BODY CIRCUMFERENCE.	DM12 264
C		DM12 265
C	INITIALIZE	DM12 266
C	IT1 = 0	DM12 267
C	IT2 = 0	DM12 268
C	IT3 = 0	DM12 269
C	IT4 = 0	DM12 270
C	IF (THETIT,GE,90. .OR. THETIT,LE,0.) GO TO 210	DM12 271
C		DM12 272
C	INTERDIGITATED TAIL EXISTS	DM12 273
C		DM12 274
C		DM12 275
C	RECALCULATE RADIUS AT AND VR,ZH COORDINATES OF FIN LOCATION	DM12 276

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C      ON THE BODY CIRCUMFERENCE FOR THE RIGHT UPPER FIN ONLY. DM12 274
C      CS=COS(THETIT*DTUR) DM12 279
C      SN=SIN(THETIT*DTUR) DM12 280
C      RAD=FRAD(SN,CS) DM12 281
C      YBOD=RAD*CS DM12 282
C      ZBOD=RAD*SN DM12 283
C      DM12 284
C      DM12 285
C      CHECK RATIO OF APPROXIMATE ARC LENGTH ON EITHER SIDE OF THETIT. DM12 286
C      DM12 287
C      DM12 288
C      DM12 289
C      ARCUS=SQRT(YBOD**2+(ZBOD-RA)**2) DM12 290
C      ARCS=SQRT((RB-YBOD)**2+ZBOD**2) DM12 291
C      DARC=(ARCUS+ARCS)/FLOAT(MS90) DM12 292
C      DM12 293
C      DETERMINE NUMBER OF PANELS BETWEEN Y-AXIS AND FIN LOCATION ON THE DM12 294
C      BODY CIRCUMFERENCE. DM12 295
C      DM12 296
C      IT1= IFIX((ARCS/DARC)+0.5) DM12 297
C      IT1= MAX0(IT1,1) DM12 298
C      IT1= MIN0(IT1,MS90-1) DM12 299
C      DM12 300
C      DTHTS IS INCREMENT BETWEEN PANELS ON RIGHT AND LEFT (0=THETIT) DM12 301
C      DTHTU IS INCREMENT BETWEEN PANELS ON TOP AND BOTTOM (THETIT=90) DM12 302
C      DM12 303
C      DTHTS = THETIT/IT1 DM12 304
C      DTHTU = (90.-THETIT)/(MS90-IT1) DM12 305
C      IT2 = MS180-IT1 DM12 306
C      IT3 = MS180+IT1 DM12 307
C      IT4 = MSWP-IT1 DM12 308
210 CONTINUE DM12 309
C      DM12 310
C      HERE K HAS ONE VALUE FOR EACH RING OF HIP*S DM12 311
C      FOR EACH CIRCUMFERENTIAL RING, THE X FRONT POSITION, XFBIP(L) DM12 312
C      IS A CONSTANT == DM12 313
C      XFBIP(L) IS THE X-POSITION OF THE BODY RING IN WING COORDINATES DM12 314
C      DM12 315
201 KX=0 DM12 316
C      DO 230 K=1, NHIP, MMSWP DM12 317
C      XS=KX*DX DM12 318
C      KP=K+MMSWP-1 DM12 319
C      DM12 320
C      L IS BODY PANEL INDEX DM12 321
C      DM12 322
C      DO 220 L=K,KP DM12 323
C      XFBIP(L)=XS DM12 324
220 CONTINUE DM12 325
C      KX=KX+1 DM12 326
230 CONTINUE DM12 327
C      DM12 328
C      CALCULATE THE TRIG FUNCTIONS OF THE ANGLES ASSOCIATED WITH EACH DM12 329
C      HIP. THIS LOOP EXECUTES ONCE FOR EACH DIFFERENT HIP ORIENTATION, DM12 330
C      SETS THE FUNCTIONS FOR ALL HIP*S THAT ARE AT THE SAME ANGLE. DM12 331
C      DM12 332
C      ANG IS THE ANGLE OF ROTATION OF THE HIP WITH RESPECT TO THE WING DM12 333
C      COORDINATE SYSTEM. DM12 334
C      THY IS THE POLAR ANGLE OF THE HIP WITH RESPECT TO THE WING Y-AXIS. DM12 335
C      DM12 336
C      DM12 337
C      BODY PANEL NUMBERING BEGINS AT Z=0, Y=RB AND PROCEEDS DM12 338
C      COUNTERCLOCKWISE IN ANGLE, THEN INCREMENTED IN X. DM12 339
C      DM12 340
C      IK = 0

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	THTIDG = 0.0	0412 341
	YIM1 = RH	0412 342
	ZIM1 = 0.0	0412 343
C		0412 344
C	I IS THE RUNNING INDEX ON THE BODY CIRCUMFERENCE.	0412 345
	DO 260 I=1,MSWP	0412 346
C		0412 347
C	GENERATE ANGLE TO BE INCREMENTED BETWEEN TAIL SEGMENTS	0412 348
C		0412 349
	DTHT = DTHTS	0412 350
C		0412 351
C	TEST FOR UPPER OR LOWER BODY PANEL WIDTH	0412 352
C		0412 353
	IF (I.GT.IT1 .AND. I.LE.IT2) DTHT=DTHTU	0412 354
	IF (I.GT.IT3 .AND. I.LE.IT4) DTHT=DTHTU	0412 355
	THTIDG = THTIDG+DTHT	0412 356
	IF (I.EQ.MS90) THTIDG=90.	0412 357
	IF (I.EQ.MS180) THTIDG=180.	0412 358
	IF (I.EQ.MS270) THTIDG=270.	0412 359
	IF (I.EQ.MSWP) THTIDG=360.	0412 360
C		0412 361
C	COMPUTE GEOMETRY OF ELLIPTIC BODY AND PRESCRIBED ANGLE.	0412 362
C		0412 363
	THT=THTIDG+DTOR	0412 364
C		0412 365
C	COMPUTE PROPERTIES OF ELLIPTIC BODY	0412 366
C	RAD IS THE LOCAL BODY RADIUS AS A FUNCTION OF THT	0412 367
C	THT IS THE MERIDIAN ANGLE FOR THE PANEL MEASURED COUNTERCLOCKWISE	0412 368
C	FROM THE Y(+IAG) AXIS	0412 369
C		0412 370
	SN=SN(THT)	0412 371
	CS=CS(THT)	0412 372
	YI=FRAD(SN,CS)*CS	0412 373
	ZI=FRAD(SN,CS)*SN	0412 374
C		0412 375
C	CHECK FOR BODY SYMMETRY	0412 376
C		0412 377
	IF (I.GT.MS90 .AND. I.LE.MS270 .AND. TRUSYM) GO TO 250	0412 378
	IK = IK+1	0412 379
	DY=YI-YIM1	0412 380
	DZ=ZI-ZIM1	0412 381
	WHIP=SQRT(DZ*DZ+DY*DY)	0412 382
	SN2= DZ/WHIP	0412 383
	CS2=DY/WHIP	0412 384
	AREAP=WBIP*DX	0412 385
C		0412 386
C	J IS THE PANEL INDEX OF RIPS	0412 387
C	K IS THE PANEL INDEX OF KING AND BODY PANELS	0412 388
C		0412 389
	DO 240 J=IK,NHIP,MSWP	0412 390
	K=J+NPANLS	0412 391
	THTI(J)=THTIDG	0412 392
	SNT(J)=SN	0412 393
	CST(J)=CS	0412 394
	SNT2(J)=SN2	0412 395
	CST2(J)=CS2	0412 396
C		0412 397
C		0412 398
	YCPT(K)=0.5*(YI+YIM1)	0412 399
	ZCPT(K)=0.5*(ZI+ZIM1)	0412 400
C		0412 401
	SWPPLE(K)=0.0	0412 402
	SPPTE(K)=0.0	0412 403

	ARPNL(K)=AREAP	DM12 404
C		DM12 405
C	NOTE -- IN THE **HIP** SYSTEM, YLC=0 AND YRC=HIP	DM12 406
C		DM12 407
C	DEFINE HIP PANEL CORNER POINTS IN WING COORDINATE SYSTEM	DM12 408
C		DM12 409
	YLC(K)=YI	DM12 410
	YRC(K)=YIM1	DM12 411
	ZLF(K)=ZI	DM12 412
	ZLB(K)=ZI	DM12 413
	ZRF(K)=ZIM1	DM12 414
	ZRB(K)=ZIM1	DM12 415
	XLF(K)=XFRIP(J)	DM12 416
	XRF(K)=XLF(K)	DM12 417
	XLB(K)=XLF(K)+DX	DM12 418
	XRB(K)=XLB(K)	DM12 419
C		DM12 420
C	CONTROL POINT X COORDINATE IN WING SYSTEM	DM12 421
C		DM12 422
240	YCPT(K)=XFRIP(J)+FAC*DX	DM12 423
250	CONTINUE	DM12 424
	YIM1=YI	DM12 425
	ZIM1=ZI	DM12 426
260	CONTINUE	DM12 427
	RETURN	DM12 428
	END	DM12 429
	SUBROUTINE LINEQS(N,A)	DM13 1
C		DM13 2
C	VERSION: DEMON1	DM13 3
C		DM13 4
C	THIS SUBROUTINE TAKES IN SINGLE COLUMN MATRIX A(N*N), CONVERTS IT	DM13 5
C	TO SQUARE MATRIX A(N*N) AND	DM13 6
C	IP(300) REMEMBERS WHAT WAS DONE TO TRIANGULATE MATRIX A	DM13 7
C	IT IS USED IN SOLVE TO DO SAME THING TO B	DM13 8
C		DM13 9
C	DIMENSION A(N,N)	DM13 10
C		DM13 11
C	LOGICAL ASYM,BODY,DELTA,NOSYM	DM13 12
C		DM13 13
C	COMMON/ONE/DUM1(6000),IP(300),DUM2(100),DUM3(54),ASYM,BODY,DELTA,	DM13 14
C	INOSYM	DM13 15
C		DM13 16
	IP(N)=1	DM13 17
	DO 6 K=1,N	DM13 18
	IF(K.EQ.N)GO TO 5	DM13 19
	KP1=K+1	DM13 20
	M=K	DM13 21
	IP(K)=M	DM13 22
	IF(M.NE.K)IP(N)=IP(N)	DM13 23
	T=A(M,K)	DM13 24
	A(N,K)=A(K,K)	DM13 25
	A(K,K)=T	DM13 26
	IF(T.EQ.0.)GO TO 5	DM13 27
	DO 2 I=KP1,N	DM13 28
2	A(I,K)=A(I,K)/T	DM13 29
	DO 4 J=KP1,N	DM13 30
	T=A(M,J)	DM13 31
	A(M,J)=A(K,J)	DM13 32
	A(K,J)=T	DM13 33
	IF(T.EQ.0.)GO TO 4	DM13 34
	DO 3 I=KP1,N	DM13 35
3	A(I,J)=A(I,J)+A(I,K)*T	DM13 36

4	CONTINUE	DM13	37
5	IF(A(K,K),EQ,0.)IP(N)=0	DM13	38
6	CONTINUE	DM13	39
	RETURN	DM13	40
	END	DM13	41
	SUBROUTINE LOADS	DM14	1
C		DM14	2
C	VERSION:DEMON2.	DM14	3
C		DM14	4
C	THIS SUBROUTINE CALCULATES FORCES AND MOMENTS ACTING ON THE	DM14	5
C	WINGS OR FINS AND THE INTERFERENCE SHELL.	DM14	6
C	THEY ARE FIRST CALCULATED IN THE WING REFERENCE COORDINATE SYSTEM	DM14	7
C	AND THEN TRANSFORMED TO WIND-AXIS SYSTEM.	DM14	8
C		DM14	9
C	IN-PLANE FORCES FX AND FY1 OR FZ1 ARE ALSO COMPUTED. HERE,FX	DM14	10
C	IS POSITIVE FORWARD PARALLEL TO BODY CENTERLINE.	DM14	11
C	IN-PLANE FORCE FY2 IS CALCULATED IN SUBROUTINE SPWLD.	DM14	12
C		DM14	13
C	DIMENSION BFX(100),BFZ(100)	DM14	14
C	DIMENSION XB(150),YC(150),ZB(150)	DM14	15
C		DM14	16
C	LOGICAL ASYM,NOSYM,BODY,DELTA,ANY,ANYMO	DM14	17
C		DM14	18
C	COMMON/ONE/CIRC(250),DELTP(250),FN(250),PNLC(250),SWPPLE(250),	DM14	19
C	1SWPPTE(250),VNOR(250),XBAR(250),ZBAR(250),XCPT(250),YCPT(250),ZCPTDM14	20	
C	2(250),XLF(250),XLB(250),XRF(250),XRB(250),YLC(250),YRC(250),ZLF(250DM14	21	
C	30),ZRF(250),ZLB(250),ZRB(250),SNT(125),CST(125),SNT2(125),CST2(125DM14	22	
C	4),IP(300),XFBIP(100),A,ALFA,ALFR,ARWING,R2,P2V,ETA,ETAR,CONST,	DM14	23
C	5COSALF,COSBET,CN,DX,EM,FMACH,RCIR,SINALF,SINBET,SLOPE,TLRNC,TIPY,DM14	24	
C	6TOTLR,U,V,W,UCHK,VCHK,WCHK,WRIP,X,Y,Z,IV,IF,II,JV,MSWR,MSXL,MS*U,DM14	25	
C	7*SWD,NRIP,NCRX,NCW,NDRAG,NRP,NPP,NRP,N3P,NOCPT,NOLIN,NOUT,*PANLS,DM14	26	
C	8NPRSS,NWRP,ASYM,BODY,DELTA,NOSYM	DM14	27
C	COMMON/THREE/ANGLR,ANGLL,ANGLU,ANGLD,DELR,DELL,DELU,DELD,SHEF,REFLDM14	28	
C	COMMON/SWEEPS/VS*LER(20),VS*TER(20),VS*LEL(20),VS*TEL(20),	DM14	29
C	1 VS*LEU(20),VS*TEU(20),VS*LED(20),VS*TED(20),LVS*P,LEFT,FAC,NCWBDM14	30	
C	2,ANPNL(250),WIDTH(250)	DM14	31
C	COMMON/BVEL/BDU(150),BDV(150),BDW(150),XFLOP(150),YFLOP(150),	DM14	32
C	1 ZFLOP(150)	DM14	33
C	COMMON/SPCPRS/DLTP(150)	DM14	34
C	COMMON/VRTX/VVVTX(150),WVRTX(150),WVRTPL,WVRTX,VRTMAX	DM14	35
C	COMMON/WBTK/THTI(125),X*LE	DM14	36
C	COMMON/FRCFIS/VNOROS(150),FX(150),FY(150),FZ(150),DLTPG(150),ANYMODM14	37	
C	COMMON/VPTHVL/VVEL(500),WVEL(500),JCPT,NCPDUT,NVLIN	DM14	38
C	COMMON/SPSANG/SINALC,COSALC,SINPHI,COSPHI	DM14	39
C	COMMON/ELLIPS/RA,RB,ERATIO	DM14	40
C	COMMON/INTROT/PHIDTH,THETIT,YROD,ZROD,PHIFR,PHIFU	DM14	41
C	COMMON/DAFM/XM,ZM,CZOA,CYOA,CMOA,CLMOA,CLLOA	DM14	42
C		DM14	43
C	DATA PI/3.141592653590/	DM14	44
C		DM14	45
C		DM14	46
C	701 FORMAT(1H1,25X,21HWING PANEL PROPERTIES,///,2X,1HJ,5X,7HYCPT(J),3X,DM14	47	
C	1 10HCHORD THRU,4X,5HPANEL,3X,8HMDCHORD,9X,6HDELTA-,5X,5HFN(J),/DM14	48	
C	2 18X,8HCENTROID,6X,4HSPAN,4X,10H*EEP,DEG,7X,2HCP,///)DM14	49	
C	702 FORMAT(///,25X,21HWING PANEL PROPERTIES,///,2X,1HJ,5X,7HZCPT(J),3X,DM14	50	
C	1 10HCHORD THRU,4X,5HPANEL,3X,8HMDCHORD,9X,6HDELTA-,5X,5HFN(J),/DM14	51	
C	2 18X,8HCENTROID,6X,4HSPAN,4X,10H*EEP,DEG,7X,2HCP,///)DM14	52	
C	705 FORMAT (8X,13,7X,F10.5,2X,F10.5,2X,F10.5,2X,F10.5,2X,F10.5,DM14	53	
C	12X,F10.5,2X,F10.5)	DM14	54
C	706 FORMAT (1X,13,2(1X,F10.5),5(2X,F10.5))	DM14	55

707	FORMAT(1H1,20X,31HBODY INFLUENCE PANEL PROPERTIES//2X,1HJ,6X,	DM14	56
1	7HYCPT(J),4X,6HLENGTH,6X,5H*IDTH,6X,8H*THETA(J),2X,5H*FY(J),5X,	DM14	57
2	5H*Z(J),5X,5HFN(J),5X,8HDELTA=CP,3X,7H*GAMMA/V//)	DM14	58
710	FORMAT(1X,13,9(1X,F10,5))	DM14	59
714	FORMAT(1H1,25X,35HVELOCITIES AT PANEL CENTROID POINTS//	DM14	60
1	10X,1HJ,11X,7H*BAR(J),5X,7HYBAR(J),5X,7H*ZBAR(J),9X,1HU,11X,	DM14	61
2	1HV,11X,1HW,8X,4HVNOR//)	DM14	62
717	FORMAT(1H1,40X,19HLOADING INFORMATION//	DM14	63
X	11X,10H*MACH NUMBER = ,E12,5/	DM14	64
1	7X,18H*ANGLE OF ATTACK = ,F8,3,1X,7H*DEGREES/	DM14	65
27X	18H*SIDE SLIP ANGLE = ,F8,3,1X,7H*DEGREES/	DM14	66
3	13X,12H*ING AREA = ,F10,5/	DM14	67
4	8X,17H*REFERENCE AREA = ,F10,5/	DM14	68
5	6X,19H*REFERENCE LENGTH = ,F10,5/	DM14	69
6	3X,22H*EXPOSED WING SPAN B = ,F10,5/	DM14	70
7	3X,22H*MMENT CENTER: XM = ,F10,5/	DM14	71
8	20X,5H*ZK = ,F10,5//)	DM14	72
718	FORMAT(20X,5H*TOTAL,12X,10HFIN 1 OR R,8X,10HFIN 2 OR L,7X,	DM14	73
1	10HFIN 3 OR U,8X,10HFIN 4 OR D,5X,13H*INTERF. SHELL, /	DM14	74
2	6X,19H*DEFL. ANGLE DEG. = ,12X,4(6X,F12,5)/	DM14	75
*	18X,7H*CTHR = ,E12,5,4(6X,F12,5)/	DM14	76
3	20X,5H*Z = ,E12,5,5(6X,E12,5)/	DM14	77
4	20X,5H*CY = ,E12,5,5(6X,E12,5)/	DM14	78
5	20X,5H*CM = ,E12,5,5(6X,E12,5)/	DM14	79
6	19X,6H*CLN = ,E12,5,5(6X,E12,5)/	DM14	80
7	19X,6H*CLL = ,E12,5,5(6X,E12,5)/	DM14	81
*	//,20X,33H*FOLLOWING ARE IN WIND-AXIS SYSTEM//	DM14	82
8	20X,5H*CL = ,E12,5,5(6X,E12,5)/	DM14	83
*	16X,9H*CY*WIND = ,E12,5,5(6X,E12,5)/	DM14	84
9	19X,6H*CDI = ,E12,5,5(6X,E12,5)/	DM14	85
1	14X,12H*CDI/CL**2 = ,E12,5/	DM14	86
*	16X,9H*CM*WIND = ,E12,5,5(6X,E12,5)/	DM14	87
*	15X,10H*CLN*WIND = ,E12,5,5(6X,E12,5)////)	DM14	88
725	FORMAT(//1X,28HU/VINF TYPE LOADING PRESSURE//)	DM14	89
726	FORMAT(//1X,32H*BERNOULLI TYPE LOADING PRESSURE//)	DM14	90
727	FORMAT(1H1,27X,40HVELOCITIES AT PANEL OUTBOARD AFT CORNERS//	DM14	91
728	FORMAT(1H0,9X,1HJ,11X,6H*XR(J),6X,6H*YR(J),6X,6H*ZR(J),10X,1HU,	DM14	92
1	11X,1HV,11X,1HW,8X,4HVNOR//)	DM14	93
729	FORMAT(1H0,9X,1HJ,11X,6H*XL(J),6X,6H*YL(J),6X,6H*ZL(J),10X,1HU,	DM14	94
1	11X,1HV,11X,1HW,8X,4HVNOR//)	DM14	95
730	FORMAT(///10X,61H*NOTE: L.E. OF LEAD PANEL IN FIRST CHORDWISE ROW	DM14	96
	ITS SUPERSONIC//)	DM14	97
		DM14	98
		DM14	99
		DM14	100
		DM14	101
		DM14	102
	CALCULATE WING AND BODY PANEL INDUCED VELOCITIES AT THE CENTROID	DM14	103
	POINTS AND OUTBOARD AFT CORNER OF FIN CONSTANT U-VELOCITY PANELS	DM14	104
	ALSO ADD VELOCITIES DUE TO FIXED VORTICES AND/OR MOVING VORTICES.	DM14	105
		DM14	106
		DM14	107
	IF BODY WAS ELLIPTICAL CROSS SECTION, USE RDU,RDV,RDW CAL-	DM14	108
	CULATED AT FIN CONTROL POINTS.	DM14	109
		DM14	110
	IF (NDRAG,EQ,0) GO TO 513	DM14	111
	NOCPT=1	DM14	112
	II=1	DM14	113
	IF=N*NB	DM14	114
	IF (NDUT,EQ,1) WRITE (6,716)	DM14	115
	DO 508 J=1,NPANELS	DM14	116
	XFLOP(J)=XBAR(J)	DM14	117
	YFLOP(J)=YCPT(J)	DM14	118



508	ZFLDP(J)=ZCPT(J)	DM14	119
	NSTART=1	DM14	120
	IF (BODY,AND,RA,EQ,RB) CALL VELCAL(NPANLS,ALFR,HETAP,NSTART)	DM14	121
	DO 510 J=1,NPANLS	DM14	122
	CALL VELNOR(XHAR(J),YCPT(J),ZBAR(J))	DM14	123
	UCT=UCHK	DM14	124
	VCT=VCHK	DM14	125
	WCT=WCHK	DM14	126
	IF(J,GT,NMP) GO TO 509	DM14	127
	VNOR(J)=UCHK+BDV(J)+VEL(J)+WVRTX(J)	DM14	128
	GO TO 512	DM14	129
509	VNOR(J)=VCHK+BDV(J)+VEL(J)+WVRTX(J)	DM14	130
512	CONTINUE	DM14	131
	IF (NOUT,NE,1) GO TO 510	DM14	132
	WRITE (6,705) J,XHAR(J),YCPT(J),ZBAR(J),UCT,VCT,WCT,VNOR(J)	DM14	133
510	CONTINUE	DM14	134
	HERE N=1.....RIGHT HOR. FIN	DM14	135
	N=2.....LEFT HOR. FIN	DM14	136
	N=3.....UPPER VERT. FIN	DM14	137
	N=4.....LOWER VERT. FIN	DM14	138
		DM14	139
		DM14	140
	IF(NOUT,EQ,1) WRITE (6,727)	DM14	141
	N=0	DM14	142
	JSTART=1	DM14	143
	JTIP=NRP+NCW+1	DM14	144
	TIPCHD=XRR(NRP)-XRF(JTIP)	DM14	145
	JEND=NRP	DM14	146
607	N=N+1	DM14	147
	IF (NOUT,EQ,1,AND,(N,EQ,1,OR,N,EQ,3)) GO TO 911	DM14	148
	IF (NOUT,EQ,1) WRITE (6,729)	DM14	149
	GO TO 912	DM14	150
911	WRITE (6,728)	DM14	151
912	DO 608 J=JSTART,JEND	DM14	152
	IF (N,EQ,2,OR,N,EQ,4) GO TO 908	DM14	153
	XFLDP(J)=XRR(J)	DM14	154
	YFLDP(J)=YRC(J)	DM14	155
	ZFLDP(J)=ZRR(J)	DM14	156
	XR(J)=XRR(J)	DM14	157
	YC(J)=YRC(J)	DM14	158
	ZH(J)=ZRR(J)	DM14	159
		DM14	160
	FOR WINGS WITH SIDE EDGES:	DM14	161
	IF L.E. SWEEP OF CIRCUMWISE ROK NEAREST THE TIP IS SUBSONIC,	DM14	162
	MOVE THE OUTBOARD CORNER OUT ONE PANEL WIDTH	DM14	163
		DM14	164
	IF (TIPCHD,LT,100.0*TLRNC) GO TO 608	DM14	165
	IF (N,EQ,1,AND,J,GE,JTIP,AND,SPPLE(JTIP),GT,HETA) GO TO 909	DM14	166
	IF (N,EQ,3,AND,J,GE,JTIP,AND,SPPLE(JTIP),GT,HETA) GO TO 925	DM14	167
	GO TO 608	DM14	168
909	YC(J)=YRC(J)+1.0*WIDTH(J)	DM14	169
	GO TO 608	DM14	170
925	ZH(J)=ZRR(J)+1.0*WIDTH(J)	DM14	171
	GO TO 608	DM14	172
908	XFLDP(J)=XLR(J)	DM14	173
	YFLDP(J)=YLC(J)	DM14	174
	ZFLDP(J)=ZLH(J)	DM14	175
	XB(J)=XLR(J)	DM14	176
	YC(J)=YLC(J)	DM14	177
	ZH(J)=ZLH(J)	DM14	178
		DM14	179
	IF (TIPCHD,LT,100.0*TLRNC) GO TO 608	DM14	180
	IF (N,EQ,2,AND,J,GE,JTIP,AND,ABS(SPPLE(JTIP)),GT,HETA) GO TO 924	DM14	181
	IF (N,EQ,4,AND,J,GE,JTIP,AND,ABS(SPPLE(JTIP)),GT,HETA) GO TO 926	DM14	181

GO TO 608	0414 182
924 YC(J)=YIC(J)=1.0*IDTH(J)	0414 183
GO TO 608	0414 184
926 ZB(J)=ZRB(J)=1.0*IDTH(J)	0414 185
608 CONTINUE	0414 186
IF (BODY.AND.NA.EQ.PR) CALL VELCAL(JEND,ALFR,PETAP,JSTART)	0414 187
DO 610 J=JSTART,JEND	0414 188
CALL VELNDR(XR(J),YC(J),ZB(J))	0414 189
UCT=UCHK	0414 190
VCT=VCHK	0414 191
WCT=WCHK	0414 192
IF (J.GT.NHP) GO TO 915	0414 193
VNDORS(J)=WCHK*BDW(J)+WVEL(J)+WVRTX(J)	0414 194
GO TO 913	0414 195
915 VNDORS(J)=VCHK*BDV(J)+VVEL(J)+VVVRTX(J)	0414 196
913 IF (NOUT.NE.1) GO TO 610	0414 197
WRITE (6,705) J,XR(J),YC(J),ZB(J),UCT,VCT,WCT,VNDORS(J)	0414 198
610 CONTINUE	0414 199
IF (.NOT.NOSYM) GO TO 513	0414 200
IF (N.NE.1) GO TO 611	0414 201
JSTART=NRP+1	0414 202
JEND=NHP	0414 203
JTIP=NHP-NCW+1	0414 204
TIPCHD=XLH(NHP)-XLF(JTIP)	0414 205
GO TO 607	0414 206
611 IF (N.NE.2.OR.NHP.EQ.NPANELS) GO TO 612	0414 207
JSTART=NHP+1	0414 208
JEND=NHP	0414 209
JTIP=NHP-NCW+1	0414 210
TIPCHD=XLH(NHP)-XLF(JTIP)	0414 211
GO TO 607	0414 212
612 IF (N.NE.3) GO TO 513	0414 213
JSTART=NHP+1	0414 214
JEND=NPANELS	0414 215
JTIP=NPANELS-NCW+1	0414 216
TIPCHD=XLH(NPANELS)-XLF(JTIP)	0414 217
GO TO 607	0414 218
513 CONTINUE	0414 219
C	0414 220
C	0414 221
C	0414 222
C	0414 223
C	0414 224
INITIALIZE VARIABLES	0414 225
CNR=0.	0414 226
CYR=0.	0414 227
CZBIP=0.0	0414 228
CYBIP=0.0	0414 229
CMHBP=0.0	0414 230
CLAHBP=0.0	0414 231
CLLBIP=0.0	0414 232
CLFBIP=0.0	0414 233
CCIBIP=0.0	0414 234
CYMBIP=0.0	0414 235
CMHBIP=0.0	0414 236
CLASBP=0.0	0414 237
C	0414 238
C	0414 239
C	0414 240
ENTRY SPECLO	0414 241
C	0414 242
OTOR=PI/180.0	0414 243
ALFA=0.0	0414 244
CZOA=0.0	0414 245

CYDA=0.0	DM14 245
CMDA=0.0	DM14 246
CLNDA=0.0	DM14 247
CLLDA=0.0	DM14 248
CZFINU=0.0	DM14 249
CZFIND=0.0	DM14 250
CYFINU=0.0	DM14 251
CYFIND=0.0	DM14 252
CMFINU=0.0	DM14 253
CMFIND=0.0	DM14 254
CLNFU=0.0	DM14 255
CLNFD=0.0	DM14 256
CLLFU=0.0	DM14 257
CLLFD=0.0	DM14 258
CYU=0.	DM14 259
CYD=0.	DM14 260
CTHRU=0.	DM14 261
CTHRD=0.	DM14 262
CTHRR=0.0	DM14 263
CTHRL=0.0	DM14 264
CLR=0.0	DM14 265
CLL=0.0	DM14 266
CLU=0.0	DM14 267
CLD=0.0	DM14 268
CDIR=0.0	DM14 269
CDIL=0.0	DM14 270
CDIU=0.	DM14 271
CDID=0.	DM14 272
COCLS=0.0	DM14 273
CYWR=0.0	DM14 274
CYWL=0.0	DM14 275
CYWR=0.0	DM14 276
CYWR=0.0	DM14 277
CMFR=0.	DM14 278
CMFL=0.	DM14 279
CMFUR=0.	DM14 280
CMFD=0.	DM14 281
CLNFR=0.0	DM14 282
CLNFL=0.0	DM14 283
CLNFU=0.0	DM14 284
CLNFD=0.0	DM14 285
CNADRV=0.0	DM14 286
CYADRV=0.0	DM14 287
C	DM14 288
BETAY= BETAR/DTOR	DM14 289
ANYEN(I,SYN	DM14 290
ANYMOS,NOT,ASYM	DM14 291
C	DM14 292
PUT MOMENT CENTER IN WING COORDINATE SYSTEM.	DM14 293
C	DM14 294
X*BX=X*LE	DM14 295
C	DM14 296
C	DM14 297
NOTE: DLTPG IS DELTA-LOADING PRESSURE/O OR DELTA-CP	DM14 298
C	DM14 299
DO 902 I=1,NPANELS	DM14 300
IF (NPPRESS.EQ.0) DLTPG(I)=DELTP(I)	DM14 301
IF (NPPRESS.EQ.1) DLTPG(I)=DLTP(I)	DM14 302
902 CONTINUE	DM14 303
C	DM14 304
C	DM14 305
C	DM14 306
C	DM14 307
WRITE OUT BIP PANEL PROPERTIES	

C	CONTRIBUTION FROM BODY INTERFERENCE PANELS TO CZ...CNR	DM14 308
C	CONTRIBUTION FROM BODY INTERFERENCE PANELS TO CY...CYB	DM14 309
C		DM14 310
	IF (NBIP.EQ.0) GO TO 140	DM14 311
	IF (NPRESS.NE.0) GO TO 161	DM14 312
	IF (NOUT.NE.0) *RITE (6,707)	DM14 313
	DO 140 K=1,NBIP	DM14 314
	I=X+NPANLS	DM14 315
	F=DELTP(I)*ARPNL(I)	DM14 316
	FN(I)=F	DM14 317
	CALL ROTBW(0.,F,BFY(K),BFZ(K),K)	DM14 318
	CNR=CNR+BFZ(K)	DM14 319
	L=I	DM14 320
	CYB=CYB+BFY(K)	DM14 321
	CIRC(L)=0.5*DELTP(I)*DX	DM14 322
	ARM=XCPT(I)-XM*	DM14 323
	BFZM=BFZ(K)*ARM	DM14 324
	CMBIP=CMBIP+BFZM	DM14 325
	BFYM=BFY(K)*ARM	DM14 326
	CLNBIP=CLNBIP+BFYM	DM14 327
	BIPRM=BFZ(K)*YCPT(L)+BFY(K)*(ZCPT(L)-ZM)	DM14 328
	CLLBIP=CLLBIP+BIPRM	DM14 329
	IF (NOUT.NE.0)	DM14 330
	*RITE(6,710) L,YCPT(L),DX,NBIP,THTI(K),BFY(K),BFZ(K),FN(L),	DM14 331
	DELTP(L),CIRC(L)	DM14 332
140	CONTINUE	DM14 333
	CZBIP=CNR/SREF	DM14 334
	CYBIP=CYB/SREF	DM14 335
	CMBIP=CMBIP/(3REF*REFL)	DM14 336
	CLNBIP=CLNBIP/(3REF*REFL)	DM14 337
	CLLBIP=CLLBIP/(3REF*REFL)	DM14 338
	IF (ANY) GO TO 161	DM14 339
	CZBIP=2.0*CZBIP	DM14 340
	CYBIP=0.0	DM14 341
	CMBIP=2.0*CMBIP	DM14 342
	CLNBIP=0.0	DM14 343
	CLLBIP=0.0	DM14 344
161	CONTINUE	DM14 345
140	CONTINUE	DM14 346
C		DM14 347
C		DM14 348
C		DM14 349
C	CALCULATE FORCES,CZFIN,CYFIN, ACTING ON THE FINS,	DM14 350
C	PITCHING MOMENT,CMFIN,YAWING MOMENT,CLNF,ROLLIN MOMENT,CLLF.	DM14 351
C	CTHR IS THRUST FORCE, LAST LETTER DESIGNATES FIN AS FOLLOWS.	DM14 352
C	R.....HOR. RIGHT FIN	DM14 353
C	L.....HOR. LEFT FIN	DM14 354
C	U.....VERT. UPPER FIN	DM14 355
C	D.....VERT. LOWER FIN	DM14 356
C	HIP.....INTERFERENCE SHELL.	DM14 357
C		DM14 358
C	ALSO:	DM14 359
C	IN WING OR BODY COORDINATE SYSTEM,	DM14 360
C	FX.....THRUST FORCE IN NEG. X-DIR. IN PLANE OF WING/D	DM14 361
C	FY.....SIDE FORCE IN Y-DIRECTION IN PLANE OF WING/D	DM14 362
C	FZ.....UPWARDS FORCE IN Z-DIR. IN PLANE OF VERTICAL WING	DM14 363
C	NOTE: ADDITIONAL CONTRIBUTIONS TO IN PLANE FORCES ARE CALCULATED	DM14 364
C	IN SUBROUTINE SPNLD.	DM14 365
C	PRESENTLY, IN-PLANE FORCES SUITABLE FOR CRUCIFORM OR PLANAR	DM14 366
C	FINS OR WINGS ONLY.	DM14 367
C		DM14 368
C	THE 300 LOOP IS USED FOR THE RIGHT AND LEFT HORIZONTAL PANELS	DM14 369
C		DM14 370

IF (NDUT,NE,0) WRITE (6,701)	DM14 371
JL=1	DM14 372
JUB=VRP	DM14 373
IL=0	DM14 374
ANGL=ANGLR	DM14 375
SINANG=SIN(ANGL)	DM14 376
PMIF=PMIFR*DTOR	DM14 377
302 CONTINUE	DM14 378
CZFIN=0.0	DM14 379
CYFIN=0.0	DM14 380
CMFIN=0.0	DM14 381
CLNFIN=0.0	DM14 382
CLLFIN=0.0	DM14 383
CNN=0.0	DM14 384
CTHR=0.0	DM14 385
DO 301 J=JL,JU	DM14 386
AREA=AREA+ARPNL(J)	DM14 387
I=J	DM14 388
F= ARPNL(J)*DLTPG(I)	DM14 389
FN(I)=F	DM14 390
YCHK=YCPT(I)+CISBET*YHAR(I)*SINBET	DM14 391
IF (ANYMR) YCHK=YCPT(I)	DM14 392
ARM=YCPT(J)-XHW	DM14 393
CALL ROTF(0,0,F,CYP,CZP,PMIF)	DM14 394
CMPS=CZP+ARM	DM14 395
CLNPS=CYP+ARM	DM14 396
PMPS=CZP+YCPT(J)+CYP*(YCPT(J)-Z)	DM14 397
CZFIN=CZFIN+CZP	DM14 398
CYFIN=CYFIN+CYP	DM14 399
CMFIN=CMFIN+CMPS	DM14 400
CLNFIN=CLNFIN+CLNPS	DM14 401
CLLFIN=CLLFIN+PMPS	DM14 402
CNN=CNN+F	DM14 403
C	DM14 404
C	DM14 405
C	DM14 406
CIRC(J)=0.5*DLTPG(J)*PNLC(J)	DM14 407
SLPHC=0.5*(SWPPLE(J)+SWPPTE(J))	DM14 408
SWPHC=ATAN(SLPHC)*57.2957795	DM14 409
IF (NDRAG,EO,0) GO TO 299	DM14 410
FX(J)=2.*WIDTH(J)+CIRC(J)*(SINANG+VNDOR(J))	DM14 411
FY(J)=FX(J)*SLPHC	DM14 412
CYANDH=CYANDH+FY(J)	DM14 413
CTHR=CTHR+FX(J)	DM14 414
299 IF (NDUT,NE,0)	DM14 415
WRITE (6,704) J,YCPT(J),PNLC(J),WIDTH(J),SWPHC,DLTPG(J),FN(J)	DM14 416
300 CONTINUE	DM14 417
C	DM14 418
IF (IL,EO,1) GO TO 310	DM14 419
CNN=CNN/SREF	DM14 420
CZFIN=CZFIN/SREF	DM14 421
CYFIN=CYFIN/SREF	DM14 422
CMFIN=CMFIN/(SREF*REFL)	DM14 423
CLNFIN=CLNFIN/(SREF*REFL)	DM14 424
CLLFIN=CLLFIN/(SREF*REFL)	DM14 425
CTHR=CTHR/SREF	DM14 426
C	DM14 427
C	DM14 428
C	DM14 429
C	DM14 430
C	DM14 431
C	DM14 432
C	DM14 433
IF (ANY) GO TO 301	

AREA=2.0*AREA	DM14 434
IF (THETIT.NE.0.0) GO TO 303	DM14 435
GO TO 304	DM14 436
303 CZFIN=CZFINR	DM14 437
CYFIN=CYFINR	DM14 438
CMFIN=CMFINR	DM14 439
CLNFR=CLNFR	DM14 440
CLLFR=CLLFR	DM14 441
CTHR=CTHRR	DM14 442
CY=CVR	DM14 443
GO TO 311	DM14 444
304 CZFINL=CZFINR	DM14 445
CYFINL=CYFINR	DM14 446
CMFINL=CMFINR	DM14 447
CLNFL=CLNFR	DM14 448
CLLFL=CLLFR	DM14 449
CTHRL=CTHRR	DM14 450
CAL = CNR	DM14 451
CYADDH=0.0	DM14 452
GO TO 311	DM14 453
301 CONTINUE	DM14 454
C REENTER ABOVE LOOP FOR LEFT HORIZONTAL PANEL	DM14 455
C IL=1	DM14 456
JL=JU+1	DM14 457
JU=NHP	DM14 458
ANGL=ANGLL	DM14 459
SINANG=SIN(ANGL)	DM14 460
GO TO 302	DM14 461
310 CZFINL=CZFIN/SREF	DM14 462
CYFINL=CYFIN/SREF	DM14 463
CMFINL=CMFIN/(SREF*REFL)	DM14 464
CLNFL=CLNFIN/(SREF*REFL)	DM14 465
CLLFL=CLLFIN/(SREF*REFL)	DM14 466
CTHRL=CTHR/SREF	DM14 467
CAL=CNH/SREF	DM14 468
311 CONTINUE	DM14 469
IF (NHP.EQ.NPANELS) GO TO 350	DM14 470
C THE 320 LOOP IS USED FOR THE UPPER AND LOWER VERTICAL PANELS	DM14 471
C IF (NOUT.NE.0) WRITE (6,702)	DM14 472
C JL=NHP+1	DM14 473
JU=N3P	DM14 474
IL=0	DM14 475
ANGL=ANGLU	DM14 476
SINANG=SIN(ANGL)	DM14 477
PHIF=PHIFU+DTOR	DM14 478
325 CONTINUE	DM14 479
CZFIN=0.0	DM14 480
CYFIN=0.0	DM14 481
CMFIN=0.0	DM14 482
CLNFIN=0.0	DM14 483
CLLFIN=0.0	DM14 484
CYV=0.0	DM14 485
CTHR=0.0	DM14 486
DO 320 J=JL,JU	DM14 487
I=J	DM14 488
F=ARP*L(J)*DLTPG(I)	DM14 489
F*(I)=F	DM14 490
ZCHK=ZCPT(I)*COSALF+XBAR(I)*SINALF	DM14 491
IF (ANYMO) ZCHK=ZCPT(I)	DM14 492
	DM14 493
	DM14 494
	DM14 495
	DM14 496

ARM=XCPT(J)=X*W	DM14 497
CALL ROTFN(0.0,F,CYP,CZP,PHIF)	DM14 498
CMP=CZP*ARM	DM14 499
CLNP=CYP*ARM	DM14 500
PRM=CZP*YCHT(J)+CYP*(ZCPT(J)-ZM)	DM14 501
CZFIN=CZFIN+CZP	DM14 502
CYFIN=CYFIN+CYP	DM14 503
CMFIN=CMFIN+CMF	DM14 504
CLNFIN=CLNFIN+CLNP	DM14 505
CLLFIN=CLLFIN+PRM	DM14 506
CYY=CYY+F	DM14 507
CIRC(J)=0.5*DLTPG(J)*PNLC(J)	DM14 508
SLPMC=0.5*(S*PPL(J)+SWPPE(J))	DM14 509
S*PMC=ATAN(SLPMC)*57.2957795	DM14 510
IF (NDRAG.EQ.0) GO TO 319	DM14 511
FX(J)=2.*WIDTH(J)*CIRC(J)*(SINANG-VNOR(J))	DM14 512
FZ(J)=FX(J)*SLPMC	DM14 513
CNADDV=CNADDV+FZ(J)	DM14 514
CTHR=CTHR+FX(J)	DM14 515
319 IF (NDUT.NE.0)	DM14 516
1-RTF (6,706) J,ZCPT(J),PNLC(J),WIDTH(J),SWPMC,DLTPG(J),FN(J)	DM14 517
320 CONTINUE	DM14 518
IF (IL.EQ.1) GO TO 330	DM14 519
CZFIN=CZFIN/SREF	DM14 520
CYFIN=CYFIN/SREF	DM14 521
CMFIN=CMFIN/(SREF*REFL)	DM14 522
CLNFIN=CLNFIN/(SREF*REFL)	DM14 523
CLLFIN=CLLFIN/(SREF*REFL)	DM14 524
CTHR=CTHR/SREF	DM14 525
CYU=CYY/SREF	DM14 526
IF (ANY) GO TO 321	DM14 527
IF (THEIT.NE.0.0) GO TO 322	DM14 528
GO TO 350	DM14 529
322 CZFINL=CZFINU	DM14 530
CYFINL=CYFINU	DM14 531
CMFINL=CMFINU	DM14 532
CLNFINL=CLNFINU	DM14 533
CLLFINL=CLLFINU	DM14 534
CTHRL=CTHRU	DM14 535
CNL=CYU	DM14 536
GO TO 350	DM14 537
321 CONTINUE	DM14 538
C	DM14 539
C REENTER ABOVE LOOP FOR LOWER VERTICAL PANEL	DM14 540
C	DM14 541
IL=1	DM14 542
JL=JU+1	DM14 543
JU=NPANLS	DM14 544
ANGLE=ANGLO	DM14 545
SINANG=SIN(ANGL)	DM14 546
GO TO 325	DM14 547
330 CZFIN=CZFIN/SREF	DM14 548
CYFIN=CYFIN/SREF	DM14 549
CMFIN=CMFIN/(SREF*REFL)	DM14 550
CLNFIN=CLNFIN/(SREF*REFL)	DM14 551
CLLFIN=CLLFIN/(SREF*REFL)	DM14 552
CTHR=CTHR/SREF	DM14 553
CYU=CYY/SREF	DM14 554
350 CONTINUE	DM14 555
C	DM14 556
C	DM14 557
C	DM14 558
C	DM14 559

C		DM14	560
C	OVERALL FORCE AND MOMENT COEFFICIENTS FOR FINS AND INTERFERENCE	DM14	561
C	SHELL IN WING OR BODY REFERENCE SYSTEM.	DM14	562
C		DM14	563
C	CTHROA.....ACTS ALONG NEGATIVE X-AXIS	DM14	564
C	CYOA.....ACTS ALONG POSITIVE Y-AXIS	DM14	565
C	CZOA.....ACTS ALONG POSITIVE Z-AXIS	DM14	566
C	CMOA.....VECTOR ALONG NEGATIVE Y-AXIS, NOSE UP POS.	DM14	567
C	CLNOA.....VECTOR ALONG POSITIVE Z-AXIS, NOSE TO RIGHT POS.	DM14	568
C	CLLOA.....VECTOR ALONG POSITIVE X-AXIS, RIGHT WING DOWN POS.	DM14	569
C		DM14	570
C	CNADDV,CYADDH,...ADDITIONS TO CZOA,CYOA DUE TO IN PLANE FORCES, NOT	DM14	571
C	SUCTION CONVERSION TO NORMAL FORCE.	DM14	572
C		DM14	573
C	FORCE COEFFICIENTS IN X,Y,Z DIRECTIONS.	DM14	574
C		DM14	575
C	CTHROA=CTHRR+CTHRL+CTHRU+CTHRD	DM14	576
C	CZOA=CZFIR+CZFIL+CZFIND+CZHIP	DM14	577
C	CYOA=CYFIR+CYFIL+CYFIND+CYHIP	DM14	578
C	CNADDV=CNADDV/SREF	DM14	579
C	CYADDH=CYADDH/SREF	DM14	580
C		DM14	581
C	PITCHING,YAWING,ROLLING MOMENTS COEFFICIENTS.	DM14	582
C		DM14	583
C	CMOA=CMFIR+CMFIL+CMFIND+CMHIP	DM14	584
C	CLNOA=CLNFR+CLNFL+CLNFU+CLNFD+CLNBIP	DM14	585
C	CLLOA=CLLFR+CLLFL+CLLFU+CLLFD+CLLBIP	DM14	586
C		DM14	587
C		DM14	588
C	OVERALL FORCE AND MOMENT COEFFICIENTS IN WIND-AXIS SYSTEM(EXCEPT	DM14	589
C	ROLLING MOMENT)	DM14	590
C		DM14	591
C	CDI.....ACTS BACK ALONG FREE STREAM DIRECTION, X-WIND-AXIS	DM14	592
C	CYW.....ACTS TO THE RIGHT NORMAL TO FREE STREAM VECTOR=BODY	DM14	593
C	CENTER LINE PLANE, Y-WIND-AXIS	DM14	594
C	CL.....ACTS UPWARDS IN FREE STREAM VECTOR=BODY CENTERLINE	DM14	595
C	PLANE NORMAL TO FREE STREAM VECTOR, Z-WIND-AXIS	DM14	596
C	CMOAW...VECTOR ALONG NEGATIVE Y-WIND-AXIS, NOSE UP POS.	DM14	597
C	CLNOAW...VECTOR ALONG POSITIVE Z-WIND-AXIS, NOSE TO RIGHT, POS.	DM14	598
C		DM14	599
C	DRAG,LATERAL,LIFT FORCE COEFFICIENTS	DM14	600
C		DM14	601
C	CDIR=CTHRR*COSALC-CYFIR*SINALC*SINPHI+CZFIR*SINALC*COSPHI	DM14	602
C	COIL=CTHRL*COSALC-CYFIL*SINALC*SINPHI+CZFIL*SINALC*COSPHI	DM14	603
C	CDIU=CTHRU*COSALC-CYFIND*SINALC*SINPHI+CZFIND*SINALC*COSPHI	DM14	604
C	CDID=CTHRD*COSALC-CYFIND*SINALC*SINPHI+CZFIND*SINALC*COSPHI	DM14	605
C	CDIRIP=CYRIP*SINALC*SINPHI+CZRIP*SINALC*COSPHI	DM14	606
C	CDI=CDIR+COIL+CDIU+CDID+CDIRIP	DM14	607
C		DM14	608
C		DM14	609
C	CYWR=CZFIR*SINPHI+CYFIR*COSPHI	DM14	610
C	CYL=CZFIL*SINPHI+CYFIL*COSPHI	DM14	611
C	CYU=CZFIND*SINPHI+CYFIND*COSPHI	DM14	612
C	CYD=CZFIND*SINPHI+CYFIND*COSPHI	DM14	613
C	CYWRIP=CZRIP*SINPHI+CYRIP*COSPHI	DM14	614
C	CY=CYWR+CYL+CYU+CYD+CYWRIP	DM14	615
C		DM14	616
C		DM14	617
C	CLR=CTHRR*SINALC-CYFIR*COSALC*SINPHI+CZFIR*COSALC*COSPHI	DM14	618
C	CLL=CTHRL*SINALC-CYFIL*COSALC*SINPHI+CZFIL*COSALC*COSPHI	DM14	619



	CLU=CTHRII*SINALC-CYFINU*COSALC*SINPHI+CZFINU*COSALC*COSPHI	DM14 620.
	CLD=CTHRO*SINALC-CYFIND*COSALC*SINPHI+CZFIND*COSALC*COSPHI	DM14 621
	CLBIP=-CYBIP*COSALC*SINPHI+CZBIP*COSALC*COSPHI	DM14 622
	CL=CLR+CLL+CLU+CLD+CLBIP	DM14 623
	COCLS=CDT/(CL*CL)	DM14 624
C		DM14 625
C	PITCHING, YAWING MOMENTS	DM14 626
C		DM14 627
	CMFR=-CMFINR*COSPHI-CLNFR*SINPHI	DM14 628
	CMFL=-CMFINL*COSPHI-CLNFL*SINPHI	DM14 629
	CMFU=-CMFINU*COSPHI-CLNFU*SINPHI	DM14 630
	CMFD=-CMFIND*COSPHI-CLNFD*SINPHI	DM14 631
	CMBIP=-CMBIP*COSPHI-CLNBIP*SINPHI	DM14 632
	CMQAW=CMFR+CMFL+CMFU+CMFD+CMBIP	DM14 633
C		DM14 634
C		DM14 635
	CLNFR=-CLLFR*SINALC+CMFINR*COSALC*SINPHI+CLNFR*COSALC*COSPHI	DM14 636
	CLNFL=-CLLFL*SINALC+CMFINL*COSALC*SINPHI+CLNFL*COSALC*COSPHI	DM14 637
	CLNFU=-CLLFU*SINALC+CMFINU*COSALC*SINPHI+CLNFU*COSALC*COSPHI	DM14 638
	CLNFD=-CLLFD*SINALC+CMFIND*COSALC*SINPHI+CLNFD*COSALC*COSPHI	DM14 639
	CLNBIP=-CLLBIP*SINALC+CMBIP*COSALC*SINPHI+CLNBIP*COSALC*COSPHI	DM14 640
	CLNOAW=CLNFR+CLNFL+CLNFU+CLNFD+CLNBIP	DM14 641
C		DM14 642
C		DM14 643
C	WRITE ALL LOADING RESULTS.	DM14 644
C		DM14 645
	SPAN=2.0*H2	DM14 646
	WRITE(6,717) FMACH,ALFA,BETAY,AREA,SREF,REFL,SPAN,XH,ZH	DM14 647
	IF (NPRESS.EQ.0) WRITE(6,725)	DM14 648
	IF (NPRESS.EQ.1) WRITE(6,726)	DM14 649
	WRITE(6,718) DELR,DELL,DELU,DELD,	DM14 650
	1 CTHOA,CTHRR,CTHRL,CTHRU,CTHRD,	DM14 651
	2 CZOA,CZFIR,CZFIL,CZFINU,CZFIND,CZBIP,	DM14 652
	3 CYOA,CYFIR,CYFIL,CYFINU,CYFIND,CYBIP,	DM14 653
	4 CMOA,CMFIR,CMFIL,CMFINU,CMFIND,CMBIP,	DM14 654
	5 CLNOA,CLNFR,CLNFL,CLNFU,CLNFD,CLNBIP,	DM14 655
	6 CLLQA,CLLFR,CLLFL,CLLFU,CLLFD,CLLBIP,	DM14 656
	7 CL,CLR,CLL,CLU,CLD,CLBIP,	DM14 657
	* CYN,CYP,CYNL,CYU,CYUO,CYBIP,	DM14 658
	8 CDI,CDIR,CDIL,CDIU,CDID,CDIBIP,	DM14 659
	9 COCLS,	DM14 660
	*CMQAW,CMFR,CMFL,CMFU,CMFD,CMBIP,	DM14 661
	*CLNOAW,CLNFR,CLNFL,CLNFU,CLNFD,CLNBIP	DM14 662
C		DM14 663
C	CHECK ON SUPERSONIC L.E. BASED ON L.E. SWEEP OF INBOARD	DM14 664
C	CHORD=ISE NOW	DM14 665
C		DM14 666
	ARGTAN=1.0/BETA	DM14 667
	ANGMCH=(ATAN(ARGTAN))*57.2957795	DM14 668
	PSIMCH=90.0+ANGMCH	DM14 669
	PSIPLE=(ATAN(SWPPLE(1)))*57.2957795	DM14 670
	IF (PSIMCH.GT.PSIPLE) WRITE(6,730)	DM14 671
C		DM14 672
C		DM14 673
C		DM14 674
C		DM14 675
	IF (THFIT,NE.0.0) RETURN	DM14 676
	CALL SPNU	DM14 677
	RETURN	DM14 678
	END	DM14 679

C	SUBROUTINE OUT(A,N)	DM15	1
C	VERSION: DEMON1	DM15	2
C		DM15	3
	DIMENSION A(N,N)	DM15	4
	1 FORMAT(10(1X,E11.4))	DM15	5
	2 FORMAT(1H )	DM15	6
	DO 100 I=1,N	DM15	7
	*WRITE (6,1) (A(I,J),J=1,N)	DM15	8
100	WRITE(6,2)	DM15	9
	RETURN	DM15	10
	END	DM15	11
		DM15	12
C	SUBROUTINE ROTATE(VIN,ZIN,VOUT,ZOUT,PHIF)	DM16	1
C	VERSION: DEMON2.	DM16	2
C		DM16	3
C	THIS SUBROUTINE ROTATES LOCAL COORDINATES RELATIVE TO CONSTANT	DM16	4
C	U-VELOCITY PANEL CORNERS AND PARALLEL TO WING COORDINATE	DM16	5
C	SYSTEM TO LOCAL COORDINATES IN THE PLANE OF THE PANEL ITSELF AND	DM16	6
C	VICE VERSA.	DM16	7
C		DM16	8
	COMMON/DNE/DUM1(6400),A,DUM2(5),BETA,DUM3(6),EM,DUM4(4),SLOPE,	DM16	9
	1TLRNC,TIPY,TOTLR,U,V,N,DUM5(4),X,Y,Z,S,M,DUM6(2),MJ,DUM7(8),NHP,	DM16	10
	ZNPR,DUM8(2),NOCP,T,NULINP,NOUT,NPANS,DUM9(2),ASYM,BODY,DELTA,NOSYMD	DM16	11
	COMMON/INTROT/PHI0IN,THEIT,YR0D,ZB0D,PHIFR,PHIFU	DM16	12
C		DM16	13
	DATA PI02/1.570796326795/	DM16	14
C		DM16	15
C		DM16	16
C	WING TO FIN	DM16	17
C		DM16	18
	ENTRY ROTAF	DM16	19
	IF (ABS(PHIF-PI02),LT,TLRNC) GO TO 100	DM16	20
	GO TO 101	DM16	21
100	COSPHI=0.0	DM16	22
	SINPHI=1.0	DM16	23
	GO TO 104	DM16	24
101	CONTINUE	DM16	25
	COSPHI=COS(PHIF)	DM16	26
	SINPHI=SIN(PHIF)	DM16	27
104	CONTINUE	DM16	28
	VOUT=VIN*COSPHI+ZIN*SINPHI	DM16	29
	ZOUT=ZIN*COSPHI-VIN*SINPHI	DM16	30
	RETURN	DM16	31
		DM16	32
C		DM16	33
C	FIN TO WING	DM16	34
C		DM16	35
	ENTRY ROTFW	DM16	36
	IF (ABS(PHIF-PI02),LT,TLRNC) GO TO 102	DM16	37
	GO TO 103	DM16	38
102	COSPHI=0.0	DM16	39
	SINPHI=1.0	DM16	40
	GO TO 105	DM16	41
103	CONTINUE	DM16	42
	COSPHI=COS(PHIF)	DM16	43
	SINPHI=SIN(PHIF)	DM16	44
105	CONTINUE	DM16	45
	VOUT=VIN*COSPHI-ZIN*SINPHI	DM16	46
	ZOUT=ZIN*COSPHI+VIN*SINPHI	DM16	47
	RETURN	DM16	48
	END	DM16	49

	SUBROUTINE SOLVE (B,A,N)	DM17	1
C		DM17	2
C	VERSION: DEMON1	DM17	3
C		DM17	4
C		DM17	5
C	THIS SUBROUTINE TAKES IN THE TRIANGULATED MATRIX A, RIGHT HAND	DM17	6
C	SIDE VECTOR B, IT IS OPERATED ON BY IP(300)	DM17	7
C	SOLUTION THEN PROCEEDS, ANSWER IS IN VECTOR B AGAIN	DM17	8
C		DM17	9
	DIMENSION B(1)	DM17	10
	DIMENSION A(N,N)	DM17	11
C		DM17	12
	LOGICAL ASYM,BODY,DELTA,NOSYM	DM17	13
C		DM17	14
	COMMON/DNE/DUM1(6000),IP(300),DUM2(102),ALFR,DUM3(18),TOTLX,	DM17	15
	1DUM4(21),NDRAG,DUM5(4),NOCPT,NOLINP,NOUT,NPANLS,NPRESS,N=BP,ASYM,	DM17	16
	2BODY,DELTA,NOSYM	DM17	17
C		DM17	18
C		DM17	19
	IF(N.EQ.1)GO TO 9	DM17	20
	NM1=N-1	DM17	21
	DO 7 K=1,NM1	DM17	22
	KP1=K+1	DM17	23
	M=IP(K)	DM17	24
	T=B(M)	DM17	25
	B(M)=B(K)	DM17	26
	B(K)=T	DM17	27
	DO 7 I=KP1,N	DM17	28
	7. B(I)=B(I)+A(I,K)*T	DM17	29
C		DM17	30
C		DM17	31
	DO 8 K=1,NM1	DM17	32
	KM1=N-K	DM17	33
	K=KM1+1	DM17	34
	B(K)=B(K)/A(K,K)	DM17	35
	T=B(K)	DM17	36
	IF (T.EQ.0.0) GO TO 9	DM17	37
	DO 8 I=1,KM1	DM17	38
	8. B(I)=B(I)+A(I,K)*T	DM17	39
	9. B(1)=B(1)/A(1,1)	DM17	40
	RETURN	DM17	41
	END	DM17	42
	SUBROUTINE SOURCE(J)	DM18	1
C		DM18	2
C	VERSION: DEMON	DM18	3
C		DM18	4
C	VERSION: DEMON1	DM18	5
C		DM18	6
C	SUBROUTINE TO CALCULATE THE VELOCITIES DUE TO A LINEAR LINE SOURCE OF	DM18	7
C	UNIT SLOPE WITH ORIGIN AT TX(J).	DM18	8
C	SOLUTIONS GIVEN BY WOODWARD AND LARSEN (HOING REPT. D6-10741), EQUATION	DM18	9
C	(53) OR ANTONIO FERRI, "ELEMENTS OF AERODYNAMICS OF SUPERSONIC FLOWS,"	DM18	10
C	EQUATION (374).	DM18	11
C		DM18	12
	INTEGER RCODE	DM18	13
	COMMON/TXD/TX(101),DUM1(1113),RCODE,BETASQ,BSQ,RADIUS,XFIELD,RNOSD	DM18	14
	1,U,V,VY,XA,XC,XD,BETA,XFIELD,X2,XB,NXBODY	DM18	15
C		DM18	16
C		DM18	17
	100 FORMAT(1H0,59HFIELD POINT IS WITHIN TAIL MACH CONE. U AND V SET TO	DM18	17

C	10 ZERO,)	DM18	18
	X1=XFIELD-TX(J)	DM18	19
	NR=BETA*WFIELD	DM18	20
	IF(X1.LF,RR) GO TO 10	DM18	21
	IF(X2.LE,RR) GO TO 11	DM18	22
	WRITE(6,100)	DM18	23
	GO TO 10	DM18	24
	11 XL=X1/RR	DM18	25
	D23= SQRT(XL*XL+1.)	DM18	26
	U=ALOG(XL+D23)	DM18	27
	V=BETA+D23	DM18	28
	RETURN	DM18	29
C		DM18	30
C	FIELD POINT IS AHEAD OF MACH CONE FROM SOURCE ORIGIN.	DM18	31
C		DM18	32
	10 U=0.	DM18	33
	V=0.	DM18	34
	RETURN	DM18	35
	END	DM18	36
		DM18	37
C	SUBROUTINE SPECPR	DM19	1
C		DM19	2
C	VERSION: DEMON1	DM19	3
C		DM19	4
C	THIS SUBROUTINE COMPUTES BERNOULLI PRESSURES AT CONTROL POINTS	DM19	5
C	OF THE CONSTANT U-VELOCITY PANELS	DM19	6
C	ON THE WING OR FIN SURFACES	DM19	7
C		DM19	8
C		DM19	9
C		DM19	10
C	DIMENSION PRESSA(150),PRESSB(150),PRESSR(150),PRESSL(150)	DM19	11
C		DM19	12
C	LOGICAL BODY,ASYM,DELTA,NOSYM	DM19	13
C		DM19	14
C	COMMON/DUM/DUM1(250),DELTP(250),DUM2(1750),XCPT(250),YCPT(250),	DM19	15
	1ZCPT(250),DUM3(3402),ALFR,ARWING,DUM4(2),BETA,BETAR,CONST,COSALF,	DM19	16
	2COSBET,CN,OX,EM,FMACH,RCIR,	DM19	17
	2 SINALF,SINBET,DUM5(3),TOTLR,DUM6(3),UCHK,	DM19	18
	3VCHK,WCHK,DUM7(4),J,IF,II,K,DUM8(4),NRIP,NCPX,NCW,NDRAG,NRP,NPR,	DM19	19
	4NRP,N3P,NOCPT,NOLINP,NOUT,NPANELS,NPRESS,NWRP,ASYM,BODY,DELTA,NOSYM	DM19	20
	COMMON/HVEL/BDU(150),BDV(150),BDW(150),XFLOP(150),YFLOP(150),	DM19	21
	1 ZFLOP(150)	DM19	22
	COMMON/SPCPRS/DLTP(150)	DM19	23
	COMMON/SPSANG/SINALC,COSALC,SINPHI,COSPHI	DM19	24
	COMMON/VRTXV/VVRTX(150),NVRTX(150),NVRTPL,NVRTX,VRTMAX	DM19	25
	COMMON/THKPT/NTDAT,NCWT,NTPR,MSWT(4),NRPT,NHPT,N3PT,NTHP,ASYMT,	DM19	26
	1 NVRT,SWLET(20,4),SWTET(20,4),YTH(20,4),THETA(400)	DM19	27
	COMMON/ICVEL/UTCHK,VTCCHK,ATCHK,IIT,IFT,MJ	DM19	28
	COMMON/VPTHVL/VVEL(500),WVEL(500),JCPT,NCPDUT,NVLIN	DM19	29
	COMMON/ELLIPS/ RA,WH,ERATIO	DM19	30
C		DM19	31
C		DM19	32
C		DM19	33
	720 FORMAT(1X,I3,11F11.6)	DM19	34
	721 FORMAT(1X,I3,6F11.6,11X,3F11.6)	DM19	35
	732 FORMAT(////10X,104HVELOCITIES AND BERNOULLI PRESSURES AT CONTROL	DM19	36
	POINTS IMMEDIATELY ABOVE AND BELOW HORIZONTAL WING SURFACE//	DM19	37
	22X,1HJ,6X,4HX(J),7X,4HY(J),7X,4HZ(J),5X,5HUTOTA,6X,5HVTOTA,	DM19	38
	36X,5HATOTA,6X,6HPRESSA,5X,5HUTOTH,6X,5HVTOTH,6X,5HATOTH,	DM19	39
	46X,6HPRESSR/)	DM19	40

754	FORMAT(////10X,107HVELOCITIES AND BERNOULLI PRESSURES AT CONTROL	PDM19	41
	POINTS IMMEDIATELY TO RIGHT AND LEFT OF VERTICAL WING SURFACE//	DM19	42
	22X,1HJ,6X,4HX(J),7X,4HY(J),7X,4HZ(J),5X,5HUTOTR,6X,5HVTOTR,	DM19	43
	36X,5HWTOTR,6X,6HPPRESSR,5X,5HUTOTL,6X,5HVTOTL,6X,5HWTOTL,6X,	DM19	44
	46HPPRESSL/)	DM19	45
736	FORMAT(////3X,35HPPRESSURE LOADINGS AT CONTROL POINTS//	DM19	46
	1 2X,1HJ,7X,4HX(J),7X,4HY(J),7X,4HZ(J),4X,10HDELTP,LIN,,1X,	DM19	47
	2 11HDELTP,HERN,/)	DM19	48
737	FORMAT(1H1,77HPPRESSURE LOADINGS EXCLUDE VORTEX INDUCED COMPONENTS//	DM19	49
	1 PARALLEL TO WING SURFACES//)	DM19	50
738	FORMAT(1H1,77HPPRESSURE LOADINGS INCLUDE VORTEX INDUCED COMPONENTS//	DM19	51
	1 PARALLEL TO WING SURFACES//)	DM19	52
C		DM19	53
C		DM19	54
	NOCPT=1	DM19	55
	NHPI=NHPI+1	DM19	56
	NPNLS1=NPANLS+1	DM19	57
	IF (NVRTX.NE.0.AND.NVRTPL.EQ.0) WRITE (6,737)	DM19	58
	IF (NVRTX.NE.0.AND.NVRTPL.EQ.1) WRITE (6,738)	DM19	59
C		DM19	60
C		DM19	61
C	POINTS IMMEDIATELY ABOVE AND BELOW WING SURFACE TREATED	DM19	62
C	SEPARATELY DUE TO DISCONTINUITY IN INFLUENCE FUNCTIONS	DM19	63
C	WHEN Z EQUALS ZERO.	DM19	64
C		DM19	65
C		DM19	66
	WRITE (6,732)	DM19	67
C		DM19	68
C		DM19	69
C		DM19	70
C	WING SURFACES AND BODY INTERFERENCE PANELS CONTRIBUTION	DM19	71
C		DM19	72
	FACTR1=1.428571429/(FMACH*FMACH)	DM19	73
	FACTR2=0.2*FMACH*FMACH	DM19	74
C		DM19	75
	DO 805 J=1,NHP	DM19	76
	XFLOP(J)=XCPT(J)	DM19	77
	YFLOP(J)=YCPT(J)	DM19	78
805	ZFLOP(J)=ZCPT(J)	DM19	79
	NSTART=1	DM19	80
	IF (BODY.AND.NA.EQ.RB) CALL VELCAL(NHP,ALFR,RETAH,NSTART)	DM19	81
	DO 807 K=1,NHP	DM19	82
	VADVRT=VVRTX(K)	DM19	83
	IF (NVRTX.NE.0.AND.NVRTPL.EQ.0) VADVRT=0.0	DM19	84
C		DM19	85
C	DISCONTINUOUS CONTRIBUTION	DM19	86
C	ADD IN CONTRIBUTIONS FROM EXTERNAL VORTICES.	DM19	87
C		DM19	88
	II=K	DM19	89
	IF=K	DM19	90
	CALL VELCOR(XCPT(K),YCPT(K),ZCPT(K))	DM19	91
C		DM19	92
C	A...ABOVE B...BELOW	DM19	93
C		DM19	94
	UTOTA=UCHK+ROU(K)	DM19	95
	VTOTA=VCHK+ROV(K)+VADVRT+VVEL(K)	DM19	96
	WTOTA=ROD(K)+WVRTX(K)+WVEL(K)	DM19	97
C		DM19	98
	UTOTR=UCHK+ROU(K)	DM19	99
	VITOTR=VCHK+ROV(K)+VADVRT+VVEL(K)	DM19	100
	WITOTR=ROD(K)+WVRTX(K)+WVEL(K)	DM19	101
	IF (NOUT.NE.0)	DM19	102
	1WRITE (6,721) K,XCPT(K),YCPT(K),ZCPT(K),UTOTA,VTOTA,WTOTA,UTOTR,	DM19	103

	1 VTOTR,WTOTR	0M19 104
C		0M19 105
C	CONTINUOUS CONTRIBUTION FROM HORIZONTAL FINS	0M19 106
C		0M19 107
	II=1	0M19 108
	IF=NHMP	0M19 109
	CALL VELNHR(XCPT(K),YCPT(K),ZCPT(K))	0M19 110
	WTOTA=WTOTA+*CHK	0M19 111
	WTOTR=WTOTR+*CHK	0M19 112
	IF (NOUT.NE.0)	0M19 113
	WRITE (6,721) K,XCPT(K),YCPT(K),ZCPT(K),UTOTA,VTOTA,WTOTA,UTOTB,	0M19 114
	1 VTOTR,WTOTR	0M19 115
	IF (NHMP.EQ.NHBP) GO TO 801	0M19 116
C		0M19 117
C	CONTRIBUTION FROM VERTICAL FINS AND BODY INTERFERENCE PANELS.	0M19 118
C		0M19 119
	II=NHBP	0M19 120
	IF=NHBP	0M19 121
	CALL VELNHR(XCPT(K),YCPT(K),ZCPT(K))	0M19 122
	UTOTA=UTOTA+*CHK	0M19 123
	VTOTA=VTOTA+*CHK	0M19 124
	WTOTA=WTOTA+*CHK	0M19 125
C		0M19 126
	UTOTR=UTOTR+*CHK	0M19 127
	VTOTR=VTOTR+*CHK	0M19 128
	WTOTR=WTOTR+*CHK	0M19 129
	IF (NOUT.NE.0)	0M19 130
	WRITE (6,721) K,XCPT(K),YCPT(K),ZCPT(K),UTOTA,VTOTA,WTOTA,UTOTB,	0M19 131
	1 VTOTR,WTOTR	0M19 132
	801 CONTINUE	0M19 133
C		0M19 134
C	SOURCE PANEL CONTRIBUTION	0M19 135
C		0M19 136
	IF (NTOAT.EQ.0) GO TO 830	0M19 137
	III=1	0M19 138
	IFT=NHMP	0M19 139
	MJ=K	0M19 140
	CALL THKVEL(XCPT(K),YCPT(K),ZCPT(K))	0M19 141
	UTOTA=UTOTA+*CHK	0M19 142
	VTOTA=VTOTA+*CHK	0M19 143
	WTOTA=WTOTA+*CHK	0M19 144
	UTOTR=UTOTR+*CHK	0M19 145
	VTOTR=VTOTR+*CHK	0M19 146
	WTOTR=WTOTR+*CHK	0M19 147
	IF (NOUT.NE.0)	0M19 148
	WRITE (6,721) K,XCPT(K),YCPT(K),ZCPT(K),UTOTA,VTOTA,WTOTA,UTOTB,	0M19 149
	1 VTOTR,WTOTR	0M19 150
	830 CONTINUE	0M19 151
C		0M19 152
	HDUSQ=UTOTA*UTOTA	0M19 153
	HDSQ=VTOTA*VTOTA	0M19 154
	HDWSQ=WTOTA*WTOTA	0M19 155
	UHAR=UTOTA*CSALC=VTOTA*SINHET+*WTOTA*SINALF	0M19 156
	ARG=1,0=FACTR2*(2,0+UHAR+HDUSQ+HDSQ+HDWSQ)	0M19 157
	PRESSA(K)=*FACTH1	0M19 158
	IF (ARG.GE.10TLR) PRESSA(K)=FACTH1*(ARG+3,5-1,0)	0M19 159
	HDUSQ=UTOTR*UTOTR	0M19 160
	HDSQ=VTOTR*VTOTR	0M19 161
	HDWSQ=WTOTR*WTOTR	0M19 162
	UHAR=UTOTR*CSALC=VTOTR*SINHET+*WTOTR*SINALF	0M19 163
	ARG=1,0=FACTR2*(2,0+UHAR+HDUSQ+HDSQ+HDWSQ)	0M19 164
	PRESSA(K)=*FACTH1	0M19 165
	IF (ARG.GE.10TLR) PRESSA(K)=FACTH1*(ARG+3,5-1,0)	0M19 166

	WRITE(6,720)K,XCPT(K),YCPT(K),ZCPT(K),UTOTA,VTOTA,WTOTA,	0419 167
	1 PRESSA(K),UTOTH,VTOTH,WTOTH,PRESSB(K)	0419 168
	807 CONTINUE	0419 169
C		0419 170
C	POINTS IMMEDIATELY TO THE RIGHT AND THE LEFT OF VERTICAL	0419 171
C	WING SURFACE TREATED SEPARATELY DUE TO DISCONTINUITY IN	0419 172
C	INFLUENCE FUNCTIONS WHEN Y EQUALS ZERO.	0419 173
C	ADD IN CONTRIBUTIONS FROM EXTERNAL VORTICES.	0419 174
C		0419 175
C	IF (NCRX.EQ.0) GO TO 841	0419 176
	WRITE(6,734)	0419 177
C		0419 178
C		0419 179
	DO 808 J=NHPI,NPANELS	0419 180
	XFLDP(J)=CPT(J)	0419 181
	YFLDP(J)=YCPT(J)	0419 182
808	ZFLDP(J)=ZCPT(J)	0419 183
	NSTART=NHPI	0419 184
C		0419 185
	IF (HDDV.AND.RA.EQ.NH) CALL VELCAL(NPANELS,ALFR,HETAR,NSTART)	0419 186
	DO 813 K=NHPI,NPANELS	0419 187
	WADVRT=VVRTX(K)	0419 188
	IF (NVRTX.NE.0.AND.NVRTPL.EQ.0) WADVRT=0.0	0419 189
C		0419 190
	II=K	0419 191
	IF=K	0419 192
	CALL VELNDW(XCPT(K),YCPT(K),ZCPT(K))	0419 193
	UTOTR=UCHK+BDU(K)	0419 194
	VTOTR=BDV(K)+VVRTX(K)+VVEL(K)	0419 195
	WTOTR=CHK+BDW(K)+WADVRT+VVEL(K)	0419 196
	UTOTL=UCHK+BDU(K)	0419 197
	VTOTL=BDV(K)+VVRTX(K)+VVEL(K)	0419 198
	WTOTL=CHK+BDW(K)+WADVRT+VVEL(K)	0419 199
	IF (NOUT.NE.0)	0419 200
	1WRITE(6,721) K,XCPT(K),YCPT(K),ZCPT(K),UTOTR,VTOTR,WTOTR,UTOTL,	0419 201
	1 VTOTL,WTOTL	0419 202
C		0419 203
	II=NHPI	0419 204
	IF=NPANELS	0419 205
	CALL VELNDW(XCPT(K),YCPT(K),ZCPT(K))	0419 206
	VTOTR=VTOTR+VCHK	0419 207
	VTOTL=VTOTL+VCHK	0419 208
	IF (NOUT.NE.0)	0419 209
	1WRITE(6,721) K,XCPT(K),YCPT(K),ZCPT(K),UTOTR,VTOTR,WTOTR,UTOTL,	0419 210
	1 VTOTL,WTOTL	0419 211
C		0419 212
	II=1	0419 213
	IF=NHPI	0419 214
	CALL VELNDW(XCPT(K),YCPT(K),ZCPT(K))	0419 215
	UTOTR=UTOTR+UCHK	0419 216
	VTOTR=VTOTR+VCHK	0419 217
	WTOTR=WTOTR+CHK	0419 218
	UTOTL=UTOTL+UCHK	0419 219
	VTOTL=VTOTL+VCHK	0419 220
	WTOTL=WTOTL+CHK	0419 221
	IF (NOUT.NE.0)	0419 222
	1WRITE(6,721) K,XCPT(K),YCPT(K),ZCPT(K),UTOTR,VTOTR,WTOTR,UTOTL,	0419 223
	1 VTOTL,WTOTL	0419 224
C		0419 225
	IF (NPANELS.EQ.NHPI) GO TO 803	0419 226
	II=NPANELS	0419 227
	IF=NHPI	0419 228
	CALL VELNDW(XCPT(K),YCPT(K),ZCPT(K))	0419 229
		0419 230

UUTR=UTOTR+UCHK	DM19 231
VUTR=VTOTR+VCHK	DM19 232
WTOTR=WTOTR+WCHK	DM19 233
UTOTL=UTOTL+UCHK	DM19 234
VTOTL=VTOTL+VCHK	DM19 235
WTOTL=WTOTL+WCHK	DM19 236
C IF (NOUT.NE.0)	DM19 237
1WRITE (6,721) K,XCPT(K),YCPT(K),ZCPT(K),UTOTR,VUTR,WTOTR,UTOTL,	DM19 238
1 VTOTL,WTOTL	DM19 239
803 CONTINUE	DM19 240
C	DM19 241
C SOURCE PANEL CONTRIBUTION	DM19 242
C	DM19 243
IF (VTOAT.EQ.0) GO TO 835	DM19 244
NJ=K	DM19 245
CALL THXCEL(XCPT(K),YCPT(K),ZCPT(K))	DM19 246
UTOTR=UTOTR+UTCHK	DM19 247
VUTR=VTOTR+VCHK	DM19 248
WTOTR=WTOTR+WCHK	DM19 249
UTOTL=UTOTL+UTCHK	DM19 250
VTOTL=VTOTL+VCHK	DM19 251
WTOTL=WTOTL+WCHK	DM19 252
IF (NOUT.NE.0)	DM19 253
1WRITE (6,721) K,XCPT(K),YCPT(K),ZCPT(K),UTOTR,VUTR,WTOTR,UTOTL,	DM19 254
1 VTOTL,WTOTL	DM19 255
835 CONTINUE	DM19 256
C	DM19 257
HDUSQ=UTOTR*UTOTR	DM19 258
HDVSO=VTOTR*VTOTR	DM19 259
HDWSQ=WTOTR*WTOTR	DM19 260
UHAR=UTOTR*CHSALC=VTOTR*SINHEI+WTOTR*SINLF	DM19 261
ARG1,0=FACTR2*(2,0*(UHAR+HDUSQ+HDVSO)+HDWSQ)	DM19 262
PRESSR(K)=FACTR1	DM19 263
IF (ARG,GE,INTLR)PRESSR(K)=FACTR1*(ARG**3,5=1,0)	DM19 264
HDUSQ=UTOTL*UTOTL	DM19 265
HDVSO=VTOTL*VTOTL	DM19 266
HDWSQ=WTOTL*WTOTL	DM19 267
UHAR=UTOTL*CHSALC=VTOTL*SINHEI+WTOTL*SINLF	DM19 268
ARG1,0=FACTR2*(2,0*(UHAR+HDUSQ+HDVSO)+HDWSQ)	DM19 269
PRESSL(K)=FACTR1	DM19 270
IF (ARG,GE,INTLR)PRESSL(K)=FACTR1*(ARG**3,5=1,0)	DM19 271
WRITE (6,720) K,XCPT(K),YCPT(K),ZCPT(K),UTOTR,VUTR,WTOTR,	DM19 272
1 PRESSR(K),UTOTL,VTOTL,WTOTL,PRESSL(K)	DM19 273
813 CONTINUE	DM19 274
C	DM19 275
C	DM19 276
C CALCULATE PRESSURE DIFFERENCES AT CONTROL POINTS	DM19 277
C	DM19 278
801 CONTINUE	DM19 279
WRITE (6,730)	DM19 280
DO A21 K=1,NPALS	DM19 281
IF (K.LE.NMP) GO TO 822	DM19 282
GO TO 823	DM19 283
822 DLTP(K)=PRESSR(K)-PRESSA(K)	DM19 284
GO TO 824	DM19 285
823 DLTP(K)=PRESSR(K)-PRESSL(K)	DM19 286
824 CONTINUE	DM19 287
821 WRITE (6,720) K,XCPT(K),YCPT(K),ZCPT(K),DLTP(K),DLTP(K)	DM19 288
C	DM19 289
C	DM19 290
C CALCULATE WING LOADINGS DUE TO BERNOULLI LOADING PRESSURES	DM19 291
C	DM19 292
WPPRESS=1	DM19 293



C	CALL SPECLO	DM19 294
C		DM19 295
	RETURN	DM19 296
	END	DM19 297
		DM19 294

C	SUBROUTINE SPNLD	DM20 1
C		DM20 2
C	VERSION: DEMON1	DM20 3
C		DM20 4
C	THIS SUBROUTINE COMPUTES SPAN LOAD DISTRIBUTIONS	DM20 5
C	THIS SUBROUTINE COMPUTES SPAN LOAD DISTRIBUTIONS FOR MONOPLANE	DM20 6
C	OR CRUCIFORM WING OR FIN CONFIGURATIONS ONLY.	DM20 7
C	NOTE: INTERDIGITATED FINS PRESENTLY EXCLUDED.	DM20 8
C	ALSO ADDITIONAL IN-PLANE FORCES, FY2, FZ2,	DM20 9
C	AND SUCTION DISTRIBUTIONS ALONG THE LEADING EDGE AND SIDE EDGE.	DM20 10
C	USING THIS INFORMATION, FIN LEADING AND SIDE EDGE VORTICITY	DM20 11
C	DISTRIBUTIONS ARE CALCULATED.	DM20 12
C	IN ADDITION, FIN TRAILING EDGE VORTEX STRENGTH AND SPANWISE	DM20 13
C	LOCATION ARE DETERMINED FROM THE LOAD DISTRIBUTIONS.	DM20 14
C		DM20 15
C	DIMENSION SLOAD (20), CHORDS(150), FY2(150), FZ2(150), FT2(20),	DM20 16
C	1 YCG(20), ZCG(20), VALMAX(5), YMAX(5), VALNUM(5), ZMAX(5), SLP(20),	DM20 17
C	2 CIRNET(80), GAMMA(20)	DM20 18
C		DM20 19
C	LOGICAL ASYM, ANYMO, SSLE	DM20 20
C		DM20 21
C	COMMON/DONE/CIRC(250), DELTP(250), FN(250), PNLC(250), SWPPLE(250),	DM20 22
C	19*PPTF(250), VNMH(250), XHAR(250), ZHAR(250), XCPT(250), YCPT(250), ZCPT(250),	DM20 23
C	2(250), XLF(250), XLH(250), XRF(250), XHH(250), VLC(250), YRC(250), ZLF(250),	DM20 24
C	30), ZRF(250), ZLH(250), ZRH(250), SVT(125), CST(125), SVT2(125), CST2(125),	DM20 25
C	4), IP(300), XFHIP(100), A, ALFA, ALFR, AR, ANG, B2, P2V, BETA, BETAR, CONST,	DM20 26
C	5COSALF, COSBET, CN, CX, CY, FMACH, RCIR, SINALF, SINBET, SLOPF, TIRNC, TIPY,	DM20 27
C	6TTLR, U, V, W, UCHK, VCHK, WCHK, XHIP, XY, Z, I, IF, II, J, VSAR, SWL, SWU,	DM20 28
C	7HSHD, NHRP, NCRX, NCW, NDRA, NHP, NRP, NRP, NRP, NRP, NRP, NRP, NRP, NRP,	DM20 29
C	8NPPSS, NHRP, ASYM, MUDY, DELTA, NDSYM	DM20 30
C	COMMON/THREE/ANGLR, ANGLL, ANGLU, ANGLD, DELR, DELL, DELU, DELD, SHEF, REFL	DM20 31
C	COMMON/SAFEPS/VSWLER(20), VSWTER(20), VSWLEL(20), VSWTEL(20),	DM20 32
C	1 VSWLEU(20), VSWTEU(20), VSWLED(20), VSWTED(20), LVSWP, LEFT, FAC, NCWH	DM20 33
C	2, ARPNI(250), WIDTH(250)	DM20 34
C	COMMON/FRCDIS/VNMHDS(150), FX(150), FY(150), FZ(150), DLTPE(150), ANYMOD	DM20 35
C	COMMON/VRTX/VVRTX(150), VVRTX(150), NVRTPL, NVRTX, VRTMAX	DM20 36
C	COMMON/VPTHVL/VVEL(500), WVEL(500), JCPT, VCPOT, NVLIN	DM20 37
C	COMMON/FINLE/XLE(80), CGLOC(80), GAMLE(80), FX(2), NEGV, MLEV, MLEVL,	DM20 38
C	1 MLEVU, MLEVD	DM20 39
C	COMMON/FINSE/XSE(80), CGSELC(80), GAMSE(80), FXSF, NSIDG, NSEV	DM20 40
C	COMMON/ELLIPS/HA, PB, EQUATIO	DM20 41
C		DM20 42
C		DM20 43
C	702 FORMAT(////51X, 22HSPANWISE DISTRIBUTIONS//)	DM20 44
C	703 FORMAT (2X, I2, 2X, B(F10.5, 2X), F10.5, 1X, 2F10.5)	DM20 45
C	704 FORMAT ( 2X, I2, 2X, F10.5, 2X, F10.5, 74X, F10.5)	DM20 46
C	706 FORMAT (1X, I3, 2(1X, F10.5), 5(2X, F10.5))	DM20 47
C	707 FORMAT (////10X, 22HSIDE EDGE DISTRIBUTION//2X, 4HJTIP, 2X,	DM20 48
C	1 3HJSE, 2X, 8HDISTANCE, 7X, 13HSUCTION FORCE, 7X, 8HGAMMA, SE, 6X,	DM20 49
C	2 4HZHAR, 7X, 3HJSE/13X, 7HFROM LE, 8X, 15HPER UNIT LENGTH, 5X,	DM20 50
C	3 5H/VIN/13X, 9H/TIPCHORD, 6X, 13H/(J+TIPCHORD))	DM20 51
C	708 FORMAT (////10X, 22HSIDE EDGE DISTRIBUTION//2X, 4HJTIP, 2X,	DM20 52
C	1 3HJSE, 2X, 8HDISTANCE, 7X, 13HSUCTION FORCE, 7X, 8HGAMMA, SF, 6X,	DM20 53
C	2 4HYZHAR, 7X, 3HJSE/13X, 7HFROM LE, 8X, 15HPER UNIT LENGTH, 5X,	DM20 54

3	5H/VINF/13X,9H/TIPCHORD,6X,13H/(Q*TIPCHORD/1)	DM20	55
700	FORMAT (3X,I2,4X,I2,1X,F10.5,6X,F10.5,6X,F10.5,4X,F10.5,1X,F10.5)	DM20	56
710	FORMAT (1X,I3,9(1X,F10.5))	DM20	57
712	FORMAT (////)	DM20	58
1	10X,9HSUMFX = ,E12.5,10X,9HSUMFY1 = ,E12.5,10X,9HSUMFY2 = ,	DM20	59
1E12.5,	10X,9HSUMFZ1 = ,E12.5)	DM20	60
721	FORMAT(14I,20(1H=),410,21(1H=))	DM20	61
723	FORMAT( 3X,14I,5X,7HZ/(H/2),2X,10HCN+C/(2*B),2X,10HCT+C/(2*B),	DM20	62
1	1X,11HCZ1+C/(2*B),1X,13HCZTOT+C/(2*B),1X,10HCS+C/(2*B),5X,	DM20	63
2	5HCSINT,5X,4HZHAR,7X,9HGAMNET(I),2X,13HGAMMA,LE/VINF,2X,3HXLE/)	DM20	64
724	FORMAT( 3X,14I,5X,7HZ/(H/2),2X,10HCN+C/(2*B),2X,10HCT+C/(2*B),	DM20	65
1	1X,11HCY1+C/(2*B),1X,13HCYTOT+C/(2*B) ,1X,10HCS+C/(2*B),5X,	DM20	66
2	5HCSINT,5X,4HYZHAR,7X,9HGAMNET(I),2X,13HGAMMA,LE/VINF,2X,3HXLE/)	DM20	67
731	FORMAT (////10X,9HSUMFX = ,E12.5/10X,9HSUMFZ1 = ,E12.5/10X,	DM20	68
1	9HSUMFZ2 = ,E12.5/10X,9HSUMFZ2 = ,E12.5/)	DM20	69
733	FORMAT (////,25X,17H=ING PANEL FORCES//2X,14J,5X,7HZCPT(J),,3X,	DM20	70
1	8HDELTA=CP,6X,6HGAMMA//,6X,2HFX,10X,3HFX1, 9X,3HFX2/	DM20	71
2	32X,4HVINFL//)	DM20	72
734	FORMAT (//8X,14I,3X,3HDLT,6X,3HSLP,4X,4HISFO,3X,4HZCHK,5X,	DM20	73
1	6HVALINT,1X,4HNUM=,3X,6HVALMAX,3X,6HVALNUM,3X,4HZMAX/51X,5HEXT)	DM20	74
735	FORMAT (/7X,I2,2(1X,FA,4),2X,I2,1X,2(1X,FA,4),2X,I2,1X,	DM20	75
1	3(1X,FA,4)/)	DM20	76
736	FORMAT (////30H*****T,E. FIN VORTEX INFO*****/)	DM20	77
738	FORMAT (1X,4HIVRT,1X,10HGAMMA/VINF,3X,6HY,C.G./)	DM20	78
739	FORMAT (////25X,17H=ING PANEL FORCES//2X,14J,5X,7HZCPT(J),,3X,	DM20	79
1	8HDELTA=CP,6X,6HGAMMA//,5X,2HFX,10X,3HFX1,10X,3HFX2,/	DM20	80
2	18X,4HVINFL//,10X,4HVINFL//)	DM20	81
742	FORMAT (1X,4HIVRT,1X,10HGAMMA/VINF,3X,6HZ,C.G./)	DM20	82
743	FORMAT (//8X,14I,3X,3HDLT,6X,3HSLP,4X,4HISFO,3X,4HZCHK,5X,	DM20	83
1	6HVALINT,1X,4HNUM=,3X,6HVALMAX,3X,6HVALNUM,3X,4HZMAX/51X,5HEXT)	DM20	84
C	DATA ARW/10HRIGHT WING//,ALW/10H LEFT WING//,AUW/10HUPPER WING//,	DM20	85
C	1 ADW/10HLOWER WING/	DM20	86
C	INITIALIZE	DM20	87
C	DO 903 I=1,40	DM20	88
C	903 CIRNET(I)=0.0	DM20	89
C		DM20	90
C		DM20	91
C		DM20	92
C		DM20	93
C		DM20	94
C	CALCULATE SPANWISE LOAD DISTRIBUTIONS	DM20	95
	MSWRP=MSWR+1	DM20	96
	MSWLP=MSWL+1	DM20	97
	MSWUP=MSWU+1	DM20	98
	MSWOP=MSWO+1	DM20	99
	CFC=1.0/(4.0*B2)	DM20	100
	T*NB=4.0*B2	DM20	101
	ARGTAN=1.0/BETA	DM20	102
	ANGMCH=(ATAN(ARGTAN))*57.2957795	DM20	103
	PSIMCH=90.0-ANGMCH	DM20	104
C		DM20	105
C	LOOP 542 IS FOR RIGHT AND LEFT HORIZONTAL FINS	DM20	106
C		DM20	107
	HT=1.0/HZ	DM20	108
	WRITE(6,721) ARW	DM20	109
	WRITE(6,702)	DM20	110
	WRITE(6,724)	DM20	111
	JS1	DM20	112
	TL=0	DM20	113
	ANGL=ANGLW	DM20	114
	SINANG=91N(ANGL)	DM20	115
	COSANG=C3(ANGL)	DM20	116
		DM20	117

	NSPANG=MSWRP	DM20 119
	SIGN=+1.0	DM20 119
	KUL=MSWRP	DM20 120
	ISTART=1	DM20 121
	JEND=NRP	DM20 122
	JTIP=NRP-NC+1	DM20 123
	TIPCH=XRB(NRP)-XRF(JTIP)	DM20 124
	IVRT=0	DM20 125
	IFV=0	DM20 126
540	CONTINUE	DM20 127
	CIRNET(NSPANG)=0.0	DM20 128
	I=0	DM20 129
C		DM20 130
C		DM20 131
	SUMFX=0.0	DM20 132
	SUMFY1=0.0	DM20 133
	SUMFY2=0.0	DM20 134
	SUMFT2=0.0	DM20 135
C		DM20 136
C		DM20 137
	SLP(1)=0.0	DM20 138
	DLT=0.	DM20 139
	VALINT=0.0	DM20 140
	CSINT=0.0	DM20 141
	CSMOM=0.0	DM20 142
	NUMEXT=0	DM20 143
	ISEQ=0	DM20 144
	NQEXT=0	DM20 145
C		DM20 146
C	ALL CIRNET ARE POSITIVE IN THE COUNTER CLOCKWISE DIRECTION LOOKING	DM20 147
C	FORWARD	DM20 148
C	NOTE: IN PLANE FORCE FY2 ACTS ON OUTBOARD AFT CORNER OF EACH PANEL	DM20 149
C	HERE: TL=0.....RIGHT FIN	DM20 150
C	TL=1.....LEFT FIN	DM20 151
C		DM20 152
	DO 542 K=2,KUL	DM20 153
	I=I+1	DM20 154
	IFV=IFV+1	DM20 155
	SCSMX=0.0	DM20 156
	SCSMY1=0.0	DM20 157
	SCSMY2=0.0	DM20 158
	SWPANG=ABS(ATAN(SWPPL(E(J))))	DM20 159
	COSSWP=COS(SWPANG)	DM20 160
	PSIPLE=SWPANG*57.2957795	DM20 161
	SSLE=PSIPLE*CH.GI.PSIPLE	DM20 162
	SUM1=0.0	DM20 163
	YCHK=YCPT(J)+COSMET-XHAR(J)*SINBET	DM20 164
	IF (ANYMO) YCHK=YCPT(J)	DM20 165
	YLOC=YCHK*HTW	DM20 166
	IP1=I+1	DM20 167
	IF (TL.EQ.1) GO TO 460	DM20 168
	NFRST=1	DM20 169
	ISPN=IP1	DM20 170
	IC=I	DM20 171
	XLE(IFV)=XLE(J)+(YCPT(J)-YLC(J))*SWPPL(E(J))	DM20 172
	GO TO 461	DM20 173
460	NFRST=MSWRP+1	DM20 174
	ISPN=IP1+MSWRP	DM20 175
	IC=I+MSWRP	DM20 176
	XLE(IFV)=XRF(J)+(YCPT(J)-YRC(J))*SWPPL(E(J))	DM20 177
461	CONTINUE	DM20 178
	CIRNET(ISPN)=0.0	DM20 179
	DO 541 L=1,NC	DM20 180

SUM1=SUM1+FN(J)	DM20 181
WID1=1./WIDTH(J)	DM20 182
IF (I.NE.1) GO TO 812	DM20 183
CIRNET(NFRST)=CIRNET(NFRST)-CIRC(J)*SIGN	DM20 184
812 JADJ=J+NC*	DM20 185
IF (K.EQ.KUL) GO TO 916	DM20 186
GO TO 917	DM20 187
916 CIRNET(NSPANP)=CIRNET(NSPANP)+CIRC(J)*SIGN	DM20 188
GO TO 813	DM20 189
917 CIRNET(ISPN)=CIRNET(ISPN)+(CIRC(J)-CIRC(JADJ))*SIGN	DM20 190
813 CONTINUE	DM20 191
IF (NDRAG.EQ.0) GO TO 815	DM20 192
IF (IL.EQ.1) GO TO 440	DM20 193
CHORDS(J)=XRB(J)-XRF(J)	DM20 194
GO TO 441	DM20 195
440 CHORDS(J)=XLB(J)-XLF(J)	DM20 196
441 CONTINUE	DM20 197
IF (L.EQ.NC*) CHORDS(J)=0.5*CHORDS(J)	DM20 198
FY2(J)=2.0*CHORDS(J)*CIRNET(ISPN)*(SINANG+VNDORS(J))	DM20 199
IF (FX(J).LT.0.0.(R,SSLE) GO TO 818	DM20 200
SCSMX=SCSMX+FX(J)	DM20 201
SCSMY1=SCSMY1+FY(J)	DM20 202
818 CONTINUE	DM20 203
IF (K.EQ.KUL) GO TO 816	DM20 204
SCSMY2=SCSMY2+FY2(J)	DM20 205
GO TO 815	DM20 206
816 FT2(L)=FY2(J)	DM20 207
SUMFT2=SUMFT2+FT2(L)	DM20 208
815 CONTINUE	DM20 209
C	DM20 210
C WIDTH(J) IS PANEL SPANWISE DIMENSION, ALWAYS POSITIVE.	DM20 211
C IT IS CALCULATED IN SUBROUTINE LAYOUT.	DM20 212
C	DM20 213
501 J=J+1	DM20 214
DELY=WIDTH(J-1)	DM20 215
SUMFX=SUMFX+SCSMX	DM20 216
SUMFY1=SUMFY1+SCSMY1	DM20 217
SUMFY2=SUMFY2+SCSMY2	DM20 218
FACTOR=WID1*CFE	DM20 219
C	DM20 220
C SLOAD,...,CNC/2R,SECFXX,...,CIC/1H,SECFY,...,CYC/2R,SECFY2,...,CY(TOT)	DM20 221
C /2R,SECSUC,...,CSC/2R	DM20 222
C VALINT,...,ACCUMULATED VALUE OF THE INTEGRAL (CNC/2R)*DELY OVER	DM20 223
C THE SPANWISE DIRECTION.	DM20 224
C CSINT,...,ACCUMULATED VALUE OF THE INTEGRAL (CSC/2R)*DELY OVER	DM20 225
C THE SPANWISE DIRECTION.	DM20 226
C	DM20 227
SLOAD(I)=SUM1+WID1*CFE	DM20 228
VALINT=VALINT+(SLOAD(I)*DELY)	DM20 229
IF (NDRAG.NE.0) GO TO 562	DM20 230
WRITE (6,703) IC,YLOC,SLOAD(I),CIRNET(IC)	DM20 231
IF (K.NE.KUL) GO TO 542	DM20 232
YLOC=((H2+RH)/B2)*SIGN	DM20 233
SLOTIP=0.0	DM20 234
WRITE (6,704) NSPANP,YLOC,SLOTIP,CIRNET(NSPANP)	DM20 235
GO TO 542	DM20 236
562 CONTINUE	DM20 237
IF (SSLE) GO TO 551	DM20 238
SECFXX=SCSMX*FACTOR	DM20 239
SECFY=SCSMY1*FACTOR	DM20 240
SECFY2=(SCSMY2+SCSMY1)*FACTOR	DM20 241
SECSUC=SECFXX/COSSAP	DM20 242
CSINT=CSINT+(SECSUC*DELY)	DM20 243

	COSMOM=COSMOM+ABS(YCHK*SECSUC*DELY)	DM20 244
	CGLQC(IFV)=(COSMOM/CSINT)*SIGN	DM20 245
	YEXP=CGLQC(IFV)=(RH*SIGN)	DM20 246
	GAMLE(IFV)=FALE*((CSINT*THOM)/(2.0*YEXP))*COSANG	DM20 247
	GO TO 552	DM20 248
551	SECFXX=0.0	DM20 249
	SECFY=0.0	DM20 250
	SECFY2=SECSMY2*FACTOR	DM20 251
	SECSUC=0.0	DM20 252
	CGLQC(IFV)=0.0	DM20 253
	GAMLE(IFV)=0.0	DM20 254
552	CONTINUE	DM20 255
	WRITE (6,703) IC,YLOC,SLOAD(I),SECFXX,SECFY,SECFY2,SECSUC,CSINT,	DM20 256
	1 CGLQC(IFV),CIRNET(IC),GAMLE(IFV),XLE(IFV)	DM20 257
	IF (K,NE,KUL) GO TO 525	DM20 258
	YLOC=((H2+H3)/H2)*SIGN	DM20 259
	SLOTIP=0.0	DM20 260
	WRITE (6,704) NSPANP,YLOC,SLOTIP,CIRNET(NSPANP)	DM20 261
525	CONTINUE	DM20 262
	IF (I,EO,1) GO TO 645	DM20 263
	IM1=I-1	DM20 264
	DLT=ABS(YCHK=YCHKBF)	DM20 265
	SLP(I)=(SLOAD(I)-SLOAD(IM1))/DLT	DM20 266
	REFSLP=ABS(SLOAD(I)/(10.0*H2))	DM20 267
	IF (ABS(SLP(I)),LE,REFSLP) SLP(I)=0.0	DM20 268
	IF (I,EO,2) GO TO 646	DM20 269
	IF (K,EO,KUL) GO TO 521	DM20 270
	GO TO 522	DM20 271
521	SLP(NSPANP)=SLOAD(I)/(DLT/2.0)	DM20 272
	IF (ABS(SLP(NSPANP)),LE,REFSLP) GO TO 646	DM20 273
	SLPCHK=SLP(I)	DM20 274
	IF (SLPCHK,EO,0.0) SLPCHK=SLP(I-1)	DM20 275
	IF (SLPCHK,GT,0.0,AND,SLP(NSPANP),LT,0.0) GO TO 645	DM20 276
	IF (SLPCHK,LT,0.0,AND,SLP(NSPANP),GT,0.0) GO TO 643	DM20 277
522	CONTINUE	DM20 278
	IF (SLP(I),LO,0.0) GO TO 646	DM20 279
	IF (SLPHF,EO,0.0,AND,I,GE,4) SLPHF=SLP(I-2)	DM20 280
	IF (SLPHF,GT,0.0,AND,SLP(I),LT,0.0) GO TO 643	DM20 281
	IF (SLPHF,LT,0.0,AND,SLP(I),GT,0.0) GO TO 643	DM20 282
	GO TO 646	DM20 283
C		DM20 284
C	VALMAX IS THE EXTREME VALUE OF CNC/2*H	DM20 285
C	ITS VALUE IS TAKEN EQUAL TO THE (I-1)TH VALUE OF CNC/2H	DM20 286
C	LIKEWISE YMAX	DM20 287
C	VALMAX(1) IS THE VALUE OF CNC/2H NEAREST THE ROOT	DM20 288
C		DM20 289
643	NUMEXT=NUMEXT+1	DM20 290
	ISEQ=NUMEXT+1	DM20 291
	VALMAX(1)=SLOAD(1)	DM20 292
	YMAX(1)=RH*SIGN	DM20 293
	VALMAX(ISEQ)=SLOAD(IM1)	DM20 294
	YMAX(ISEQ)=YCHKBF	DM20 295
	IF (IL,EO,0) YOUTSD=YRC(J-1-NCH)	DM20 296
	IF (IL,EO,1) YOUTSD=YLC(J-1-NCH)	DM20 297
	RSINT=SLOAD(IM1)*(YOUTSD-YMAX(ISEQ))*SIGN	DM20 298
	VALINT=RSINT+(SLOAD(1)*DELY)	DM20 299
	VALNUM(ISEQ)=VLINBF=RSINT	DM20 300
644	SLPHF=SLP(I)	DM20 301
645	YCHKBF=YCHK	DM20 302
	VLINBF=VALINT	DM20 303
	IF (K,EO,KUL,AND,NUMEXT,EO,0) GO TO 526	DM20 304
	GO TO 527	DM20 305
526	VALMAX(1)=SLOAD(1)	DM20 306

YMAX(1)=YCHK	DM20 307
VALNUM(1)=VALINT	DM20 308
NDXT=1	DM20 309
527 CONTINUE	DM20 310
IF (I.EQ.1.AND.NOUT.NE.0) WRITE (6,734)	DM20 311
IF (NOUT.NE.0) WRITE (6,735) I,DLT,SLP(I),ISEQ,YCHK,VALINT,NUMEXT,	DM20 312
1 VALMAX(ISEQ),VALNUM(ISEQ),YMAX(ISEQ)	DM20 313
IF (NOUT.NE.0.AND.K.EQ.KUL) WRITE (6,735) IP1, DLT,SLP(NSPANP),	DM20 314
1 ISEQ,YCHK,VALINT,NUMEXT,VALMAX(ISEQ),VALNUM(ISEQ),YMAX(ISEQ)	DM20 315
542 CONTINUE	DM20 316
C SUMFX=SUMFX/SREF	DM20 317
SUMFY1=SUMFY1/SREF	DM20 318
SUMFY2=SUMFY2/SREF	DM20 319
SUMFT2=SUMFT2/SREF	DM20 320
WRITE (6,712) SUMFX,SUMFY1,SUMFY2,SUMFT2	DM20 321
C	DM20 322
C SIDE FORCE PER UNIT TIPCHORD/(Q*AC)	DM20 323
C	DM20 324
IF (NDPAG.EQ.0) GO TO 600	DM20 325
IF (TIPCHD.LT.100.0*TLRNC) GO TO 600	DM20 326
TIPFPL=TIPCHD/NCW	DM20 327
DENOM=TIPCHD*TIPFPL	DM20 328
WRITE (6,708)	DM20 329
JSE=0	DM20 330
FACTRK=1.0/(FKLE*TWOH)	DM20 331
FACTRI=1.0/FACTRK	DM20 332
DO 914 JTIP=1,NCW	DM20 333
AJTIP=JTIP	DM20 334
XLCC=AJTIP*TIPFPL	DM20 335
XLCCC=XLCC/TIPCHD	DM20 336
FT=FT2(JTIP)/DENOM	DM20 337
JSE=JSE+1	DM20 338
IF (IL.EQ.1) GO TO 91A	DM20 339
JENRP=NCW+JTIP	DM20 340
XSE(JSE)=XRF(J)	DM20 341
GO TO 919	DM20 342
91A JENRP=NCW+JTIP	DM20 343
XSE(JSE)=XLF(J)	DM20 344
919 CSMDM=CSMDM+ABS((RB+R2)*FACTRK*FT2(JTIP)*FKSE)	DM20 345
CSINT=CSINT+ABS(FACTRK*FT2(JTIP)*FKSE)	DM20 346
CGSELC(JSE)=(CSMDM/CSINT)*SIGN	DM20 347
YEXP=CGSELC(JSE)*(RB*SIGN)	DM20 348
GAMSE(JSE)=((CSINT*FACTRI)/(2.0*YEXP))*COSANG	DM20 349
914 WRITE (6,709) JTIP,JSE,XLCCC,FT,GAMSE(JSE),CGSELC(JSE),XSE(JSE)	DM20 350
600 CONTINUE	DM20 351
C	DM20 352
C	DM20 353
C PRINT INDIVIDUAL PANEL FORCES	DM20 354
C	DM20 355
IF (NOUT.NE.1) GO TO 548	DM20 356
WRITE (6,733)	DM20 357
DO 550 J=JSTART,JEND	DM20 358
550 WRITE (6,706) J,YCPT(J),DLTPG(J),CIRC(J),FX(J),FY(J),FY2(J)	DM20 359
548 CONTINUE	DM20 360
C	DM20 361
C	DM20 362
C	DM20 363
C	DM20 364
C	DM20 365
C FIN TRAILING EDGE VORTICES CALCULATED NEXT.	DM20 366
C GAMMA.....GAMMA/VINF, POSITIVE COUNTERCLOCKWISE.	DM20 367
C YCG.....YHAR, MEASURED FROM BODY CENTERLINE.	DM20 368
C	DM20 369

IF (NDWAG, EQ, 0) GO TO 531	DM20 370
WRITE (6, 736)	DM20 371
WRITE (6, 738)	DM20 372
IF (NDPXT, EQ, 0) GO TO 528	DM20 373
IVRT=IVRT+1	DM20 374
GAMMA(IVRT)=(SLOAD(1)*TWOH/2, 0)*SIGN	DM20 375
YCG(IVRT)=(WB+(VALNUM(1)/SLOAD(1)))*SIGN	DM20 376
WRITE (6, 710) IVRT, GAMMA(IVRT), YCG(IVRT)	DM20 377
GO TO 531	DM20 378
528 CONTINUE	DM20 379
NLST=NUMPXT+1	DM20 380
DO 650 ISEQ=1, NLST	DM20 381
IVRT=IVRT+1	DM20 382
ISEQP1=ISEQ+1	DM20 383
IF (ISEQ, EQ, NLST) GO TO 534	DM20 384
DIFMAX=VALMAX(ISEQP1)-VALMAX(ISEQ)	DM20 385
GAMMA(IVRT)=(TWOH/2, 0)*DIFMAX*SIGN	DM20 386
YCG(IVRT)=(YMAX(ISEQP1)*VALMAX(ISEQP1)-YMAX(ISEQ)*VALMAX(ISEQ))	DM20 387
1 /DIFMAX)-(VALNUM(ISEQP1)/DIFMAX)*SIGN	DM20 388
GO TO 533	DM20 389
534 GAMMA(IVRT)=(TWOH/2, 0)*VALMAX(ISEQ)*SIGN	DM20 390
YCG(IVRT)=YMAX(ISEQ)+(VALINT/VALMAX(ISEQ))*SIGN	DM20 391
533 CONTINUE	DM20 392
WRITE (6, 710) IVRT, GAMMA(IVRT), YCG(IVRT)	DM20 393
650 CONTINUE	DM20 394
531 CONTINUE	DM20 395
C	DM20 396
C	DM20 397
IF (MSWL, EQ, 0) GO TO 549	DM20 398
IF (IL, NE, 0) GO TO 543	DM20 399
C	DM20 400
C	DM20 401
RE-ENTER ABOVE LOOP FOR LEFT HORIZONTAL WING	DM20 402
C	DM20 403
IL=1	DM20 404
KUL=MSWLP	DM20 405
JSTART=NNP+1	DM20 406
JEND=NNP	DM20 407
JTIP=NNP-NC+1	DM20 408
TIPCHD=XB(NNP)-XLF(JTIP)	DM20 409
WRITE (6, 721) ALW	DM20 410
WRITE (6, 702)	DM20 411
WRITE (6, 724)	DM20 412
ANGL=ANGLL	DM20 413
SINANG= SIN(ANGL)	DM20 414
COSANG= COS(ANGL)	DM20 415
NSPANP=NSPANP+MSWLP	DM20 416
SIGN=1.0	DM20 417
J=NNP+1	DM20 418
GO TO 540	DM20 419
543 IF (MSWU, EQ, 0) GO TO 549	DM20 420
C	DM20 421
LOOP 546 IS FOR UPPER AND LOWER FINS	DM20 422
C	DM20 423
HERE IL=0....UPPER FIN	DM20 424
C	DM20 425
IL=1....LOWER FIN	DM20 426
C	DM20 427
BTW=1.0/R2V	DM20 428
TWOH=4.0+R2V	DM20 429
WRITE (6, 721) ALW	DM20 430
WRITE (6, 702)	DM20 431
WRITE (6, 723)	DM20 432
KUL=MSWUP	
IL=0	

ANGL=ANGLU	DM20 433
SINANG=STN(ANGL)	DM20 434
COSANG=COS(ANGL)	DM20 435
NSPANP=MSWUP+NSPANP	DM20 436
SIGN=+1.0	DM20 437
J=NHDP+1	DM20 438
JSTART=NHDP+1	DM20 439
JEND=NSP	DM20 440
JTIP=NSP-NCW+1	DM20 441
TIPCHD=XRB(NSP)-XRF(JTIP)	DM20 442
540 CONTINUE	DM20 443
CIRNET(NSPANP)=0.0	DM20 444
I=0	DM20 445
SUMFX=0.0	DM20 446
SUMFZ1=0.0	DM20 447
SUMFZ2=0.0	DM20 448
SUMFT2=0.0	DM20 449
SLP(1)=0.0	DM20 450
DLT=0.0	DM20 451
VALINT=0.0	DM20 452
CSINT=0.0	DM20 453
CSMOM=0.0	DM20 454
NUMEXT=0	DM20 455
ISFO=0	DM20 456
NOEXT=0	DM20 457
DO 546 K=2,KU	DM20 458
I=I+1	DM20 459
IFV=IFV+1	DM20 460
SCSMX=0.0	DM20 461
SCSMZ1=0.0	DM20 462
SCSMZ2=0.0	DM20 463
SUM1=0.0	DM20 464
SWPANG=ABS(ATAN(SWPPL(J)))	DM20 465
COSSWP=COS(SWPANG)	DM20 466
PSIPLE=SWPANG*57.2957795	DM20 467
SSLE=PSIMCH.GT.PSIPLE	DM20 468
ZCHK=ZCPT(J)*COSALF+XHAR(J)*SINALF	DM20 469
IF (ANYMO ) ZCHK=ZCPT(J)	DM20 470
ZLOC=ZCHK*BTW	DM20 471
IP1=I+1	DM20 472
IF (IL.EQ.1) GO TO 560	DM20 473
NFRST=MSWRP+MSWLP+1	DM20 474
ISPN=IP1+MSWRP+MSWLP	DM20 475
IC=I+MSWRP+MSWLP	DM20 476
XLE(IFV)=XLF(J)+(ZCPT(J)-ZLF(J))*SWPPL(J)	DM20 477
GO TO 561	DM20 478
560 NFRST=MSWRP+MSWLP+MSWUP+1	DM20 479
ISPN=IP1+MSWRP+MSWLP+MSWUP	DM20 480
IC=I+MSWRP+MSWLP+MSWUP	DM20 481
XLE(IFV)=XRF(J)+(ZCPT(J)-ZRF(J))*SWPPL(J)	DM20 482
561 CONTINUE	DM20 483
CIRNET(ISPN)=0.0	DM20 484
C	DM20 485
NOTE: IN PLANE FORCE FZ2 ACTS ON OUTWARD AFT CORNER OF EACH PANEL	DM20 486
C	DM20 487
HERE: IL=0....UPPER FIN	DM20 488
C	DM20 489
IL=1....LOWER FIN	DM20 490
C	DM20 491
DO 545 L=1,NCW	DM20 492
SUM1=SUM1+FN(J)	DM20 493
VIDI=1./NIDTH(J)	DM20 494
IF (I.NE.1) GO TO 212	DM20 495
CIRNET(NFRST)=CIRNET(NFRST)-CIRC(J)*SIGN	



212	JADJ=J+NCW	0420	496
	IF (K, EQ, KU) GO TO 216	0420	497
	GO TO 217	0420	498
216	CIRNET(NSPANP)=CIRNET(NSPANP)+CIRC(J)*SIGN	0420	499
	GO TO 213	0420	500
217	CIRNET(ISPN)=CIRNET(ISPN)+(CIRC(J)-CIRC(JADJ))*SIGN	0420	501
213	CONTINUE	0420	502
	IF (NDHAG, EQ, 0) GO TO 317	0420	503
	IF (IL, EQ, 1) GO TO 340	0420	504
	CHORDS(J)=XRB(J)=XRF(J)	0420	505
	GO TO 341	0420	506
340	CHORDS(J)=XLB(J)=XLF(J)	0420	507
341	CONTINUE	0420	508
	IF (L, EQ, NCW) CHORDS(J)=0.5*CHORDS(J),	0420	509
	FZ2(J)=2.0*CHORDS(J)*CIRNET(ISPN)*(SINANG=VNDORS(J))	0420	510
	IF (FX(J), LT, 0.0, OR, SSLE) GO TO 342	0420	511
	SCSMX=SCSMX+FX(J)	0420	512
	SCSMZ1=SCSMZ1+FZ2(J)	0420	513
342	CONTINUE	0420	514
	IF (K, EQ, KUL) GO TO 316	0420	515
	SCSMZ2=SCSMZ2+FZ2(J)	0420	516
	GO TO 317	0420	517
316	FT2(L)=FZ2(J)	0420	518
	SUMFT2=SUMFT2+FT2(L)	0420	519
317	CONTINUE	0420	520
545	J=J+1	0420	521
	DELZ=WIDTH(J-1)	0420	522
	SUMFX=SUMFX+SCSMX	0420	523
	SUMFZ1=SUMFZ1+SCSMZ1	0420	524
	SUMFZ2=SUMFZ2+SCSMZ2	0420	525
C		0420	526
	FACTOR=WIDTH*CFR	0420	527
	SLOAD(I)=SUM1*FACTOR	0420	528
	VALINT=VALINT+(SLOAD(I)*DELZ)	0420	529
	IF (ADRAG, NE, 0) GO TO 563	0420	530
	WRITE (6, 704) IC, ZLOC, SLOAD(I), CIRNET(IC)	0420	531
	IF (K, NE, KU) GO TO 546	0420	532
	ZLOC=((B2V+RA)/B2V)*SIGN	0420	533
	SLOTIP=0.0	0420	534
	WRITE (6, 704) NSPANP, ZLOC, SLOAD(I), CIRNET(NSPANP)	0420	535
	GO TO 546	0420	536
563	CONTINUE	0420	537
	IF (SSLE) GO TO 851	0420	538
	SECFXX=SCSMX*FACTOR	0420	539
	SECFZ=SCSMZ1*FACTOR	0420	540
	SECFZ2=(SCSMZ2+SCSMZ1)*FACTOR	0420	541
	SECSUC=SECFXX/COSSWP	0420	542
	CSINT=CSINT+(SECSUC*DELZ)	0420	543
	CSMOM=CSMOM+ABS(ZCHK+SECSUC*DELZ)	0420	544
	CGLOC(IFV)=(CSMOM/CSINT)*SIGN	0420	545
	ZEXP=CGLOC(IFV)=(RA*SIGN)	0420	546
	GAMLE(IFV)=FKLE*((CSINT*T*UB)/(2.0*ZEXP))*COSANG	0420	547
	GO TO 852	0420	548
851	SECFXX=0.0	0420	549
	SECFZ=0.0	0420	550
	SECFZ2=SCSMZ2*FACTOR	0420	551
	SECSUC=0.0	0420	552
	CGLOC(IFV)=0.0	0420	553
	GAMLE(IFV)=0.0	0420	554
852	CONTINUE	0420	555
	WRITE (6, 704) IC, ZLOC, SLOAD(I), SECFXX, SECFZ, SECFZ2, SECSUC, CSINT,	0420	556
	CGLOC(IFV), CIRNET(IC), GAMLE(IFV), XLE(IFV)	0420	557
	IF (K, NE, KUL) GO TO 546	0420	558

ZLOC=((R2V+RA)/P2)*SIGN	DM20 550
SLOTIP=0.0	DM20 560
WRITE (6,704) NSPANP,ZLOC,SLOTIP,CIRNET(NSPANP)	DM20 561
560 CONTINUE	DM20 562
IF (I.EQ.1) GO TO 845	DM20 563
IM1=I-1	DM20 564
DLT=ARS(ZCHK-ZCHKBF)	DM20 565
SLP(I)=(SLOAD(I)-SLOAD(IM1))/DLT	DM20 566
REFSLP=ARS(SLOAD(I)/(10.0*R2V))	DM20 567
IF (ARS(SLP(I)),LE,REFSLP) SLP(I)=0.0	DM20 568
IF (I.EQ.2) GO TO 846	DM20 569
IF (K.EQ.KU) GO TO 821	DM20 570
GO TO 822	DM20 571
821 SLP(NSPANP)=SLOAD(I)/(DLT/2.0)	DM20 572
IF (ARS(SLP(NSPANP)),LE,REFSLP) GO TO 846	DM20 573
SLPCHK=SLP(I)	DM20 574
IF (SLPCHK.EQ.0.0) SLPCHK=SLP(I-1)	DM20 575
IF (SLPCHK.GT.0.0.AND.SLP(NSPANP).LT.0.0) GO TO 843	DM20 576
IF (SLPCHK.LT.0.0.AND.SLP(NSPANP).GT.0.0) GO TO 843	DM20 577
822 CONTINUE	DM20 578
IF (SLP(I).EQ.0.0) GO TO 846	DM20 579
IF (SLPHF.EQ.0.0.AND,I.GE.4) SLPHF=SLP(I-2)	DM20 580
IF (SLPHF.GT.0.0.AND.SLP(I).LT.0.0) GO TO 843	DM20 581
IF (SLPHF.LT.0.0.AND.SLP(I).GT.0.0) GO TO 843	DM20 582
GO TO 846	DM20 583
843 NUMEXT=NUMEXT+1	DM20 584
ISEQ=NUMEXT+1	DM20 585
VALMAX(I)=SLOAD(I)	DM20 586
ZMAX(I)=RA*SIGN	DM20 587
VALMAX(ISEQ)=SLOAD(IM1)	DM20 588
ZMAX(ISEQ)=ZCHKBF	DM20 589
IF (IL.EQ.0) ZOUTSD=ZRB(J-1-NCW)	DM20 590
IF (IL.EQ.1) ZOUTSD=ZLB(J-1-NCW)	DM20 591
RSINT=SLOAD(IM1)*(ZOUTSD-ZMAX(ISEQ))*SIGN	DM20 592
VALINT=RSINT+(SLOAD(I)*DELZ)	DM20 593
VALNUM(ISEQ)=VLINBF+RSINT	DM20 594
846 SLPHF=SLP(I)	DM20 595
845 ZCHKBF=ZCHK	DM20 596
VLINBF=VALINT	DM20 597
IF (K.EQ.KU.AND.NUMEXT.EQ.0) GO TO 826	DM20 598
GO TO 827	DM20 599
826 VALMAX(I)=SLOAD(I)	DM20 600
ZMAX(I)=ZCHK	DM20 601
VALNUM(I)=VALINT	DM20 602
NOEXT=1	DM20 603
827 CONTINUE	DM20 604
IF (T.EQ.1.AND,NOUT.NE.0) WRITE (6,743)	DM20 605
IF (NOUT.NE.0) WRITE (6,735) I,DLT,SLP(I),ISEQ,ZCHK,VALINT,NUMEXT,	DM20 606
1 VALMAX(ISEQ),VALNUM(ISEQ),ZMAX(ISEQ)	DM20 607
IF (NOUT.NE.0.AND,K.EQ.KU) WRITE (6,735) IP1, DLT,SLP(NSPANP),	DM20 608
1 ISEQ,ZCHK,VALINT,NUMEXT,VALMAX(ISEQ),VALNUM(ISEQ),ZMAX(ISEQ)	DM20 609
546 CONTINUE	DM20 610
C	DM20 611
SUMFX=SUMFX/SREF	DM20 612
SUMFZ1=SUMFZ1/SREF	DM20 613
SUMFZ2=SUMFZ2/SREF	DM20 614
SUMFT2=SUMFT2/SREF	DM20 615
WRITE (6,731) SUMFX,SUMFZ1,SUMFZ2,SUMFT2	DM20 616
C	DM20 617
C	DM20 618
C SIDE FORCE PER UNIT TIPCHORD/(Q*C)	DM20 619
C	DM20 620
IF (NDRAG.EQ.0) GO TO 400	DM20 621

	IF (TIPCHO,LT,100.0*TLWAC) GO TO 400	0420 622
	TIPEPL=TIPOCHO/NCW	0420 623
	DENOM=TIPOCHO*TIPEPL	0420 624
	WRITE (6,707)	0420 625
	FACTRK=1.0/(FKLE+THOP)	0420 626
	FACTRI=1.0/FACTRK	0420 627
	DO 414 JTIP=1,NCW	0420 628
	AJTIP=JTIP	0420 629
	XLQC=AJTIP*TIPEPL	0420 630
	XLOCOC=XLQC/TIPOCHO	0420 631
	FT=FT2(JTIP)/DENOM	0420 632
	JSE=JSE+1	0420 633
	IF (IL,EQ,1) GO TO 920	0420 634
	J=N3P=NCW+JTIP	0420 635
	XSE(JSE)=XRF(J)	0420 636
	GO TO 921	0420 637
920	J=NPAWLS=NCW+JTIP	0420 638
	XSE(JSE)=XLF(J)	0420 639
921	CSMOM=CSMOM+ABS((WA+BP)*FACTRK*FT2(JTIP)*FKSE)	0420 640
	CSINT=CSINT+ABS(FACTRK*FT2(JTIP)*FKSE)	0420 641
	CGSELC(JSE)=(CSMOM/CSINT)*SIGN	0420 642
	ZEXP=CGSELC(JSE)*(RA*SIGN)	0420 643
	GAMSE(JSE)=((CSINT*FACTRI)/(2.0*ZEXP))*COSANG	0420 644
414	WRITE (6,709) JTIP,JSE,XLOCOC,FT,GAMSE(JSE),CGSELC(JSE),XSE(JSE)	0420 645
400	CONTINUE	0420 646
C		0420 647
C	PRINT INDIVIDUAL PANEL FORCES	0420 648
C		0420 649
	IF (NQUT,EQ,0) GO TO 448	0420 650
	WRITE (6,739)	0420 651
	DO 450 J=JSTART,JEND	0420 652
450	WRITE (6,706) J,ZCPT(1),DLTPG(J),CIRC(J),FX(J),FZ(J),FZ2(J)	0420 653
448	CONTINUE	0420 654
C		0420 655
C	FIN TRAILING EDGE VORTICES CALCULATED NEXT.	0420 656
C	GAMMA,....,GAMMA/VINF, POSITIVE COUNTERCLOCKWISE.	0420 657
C	ZCG,.....,ZBAR, MEASURED FROM BODY CENTERLINE.	0420 658
C		0420 659
	IF (NDHAG,EQ,0) GO TO 631	0420 660
	WRITE (6,735)	0420 661
	WRITE (6,742)	0420 662
	IF (NDEXT,EQ,0) GO TO 628	0420 663
	IVRT=IVRT+1	0420 664
	GAMMA(IVRT)=(SLOAD(1)*THOB/2.0)*SIGN	0420 665
	ZCG(IVRT)=(WA+(VALNUM(1)/SLOAD(1)))*SIGN	0420 666
	WRITE (6,710) IVRT,GAMMA(IVRT),ZCG(IVRT)	0420 667
	GO TO 631	0420 668
628	CONTINUE	0420 669
	NLST=NUMEXT+1	0420 670
	DO 651 ISEQ=1,NLST	0420 671
	IVRT=IVRT+1	0420 672
	ISEQP1=ISEQ+1	0420 673
	IF (ISEQ,EQ,NLST) GO TO 634	0420 674
	DIFMAX=VALMAX(ISEQP1)-VALMAX(ISEQ)	0420 675
	GAMMA(IVRT)=-(THOB/2.0)*DIFMAX*SIGN	0420 676
	ZCG(IVRT)=((ZMAX(ISEQP1)*VALMAX(ISEQP1)-ZMAX(ISEQ)*VALMAX(ISEQ))	0420 677
	1/DIFMAX)-(VALNUM(ISEQP1)/DIFMAX)*SIGN	0420 678
	GO TO 633	0420 679
634	GAMMA(IVRT)=(THOB/2.0)*VALMAX(ISEQ)*SIGN	0420 680
	ZCG(IVRT)=ZMAX(ISEQ)+(ABS(VALINT/VALMAX(ISEQ)))*SIGN	0420 681
633	CONTINUE	0420 682
	WRITE (6,710) IVRT,GAMMA(IVRT),ZCG(IVRT)	0420 683
651	CONTINUE	0420 684

631 CONTINUE	DM20 685
C	DM20 686
C	DM20 687
C RE=ENTER ABOVE LOOP FOR LOWER WING	DM20 688
C	DM20 689
IF(IL.NE.0) GO TO 549	DM20 690
WRITE(6,721) ADW	DM20 691
WRITE(6,702)	DM20 692
WRITE(6,723)	DM20 693
IL=1	DM20 694
KUBMSWD+1	DM20 695
JSTART=N3P+1	DM20 696
JEND=NPANLS	DM20 697
ANGL=ANGLO	DM20 698
SINANG=SIN(ANGL)	DM20 699
NSPANP=NSPANP+MSWDP	DM20 700
SIGN=-1.0	DM20 701
J=N3P+1	DM20 702
JTIP=NPANLS=NCW+1	DM20 703
TIPCHO=XL(R(NPANLS)-XLF(JTIP)	DM20 704
GO TO 544	DM20 705
549 CONTINUE	DM20 706
C	DM20 707
C	DM20 708
RETURN	DM20 709
END	DM20 710

SUBROUTINE THETIN(MSW,MT)	DM21 1
C	DM21 2
C VERSION: DEMON1	DM21 3
C	DM21 4
C THIS ROUTINE READS THICKNESS SLOPES FOR AN ARBITRARY WING.	DM21 5
C	DM21 6
COMMON/THKUAT/NTUAT,NCWT,NTPR,MSWT(4),NRPT,NWPT,N3PT,NTHP,ASYMT,	DM21 7
1 NVERT,SWLET(20,4),SWLET(20,4),YTH(20,4),THETAL(400)	DM21 8
COMMON/THIAS/NIINIS,THET(400)	DM21 9
C	DM21 10
500 FORMAT(8F10.0)	DM21 11
C	DM21 12
MT=NCWT*MSW	DM21 13
IF(NUNIS.NE.0) GO TO 5	DM21 14
MN=0	DM21 15
DO 1 JN=1,MT,NCWT	DM21 16
MN=MN+NCWT	DM21 17
1 READ(5,500) (THET(J),J=JN,MN)	DM21 18
RETURN	DM21 19
5 READ(5,500) (THET(J),J=1,NCWT)	DM21 20
DO 6 J=2,MSW	DM21 21
JJ=(J-1)*NCWT	DM21 22
DO 6 K=1,NCWT	DM21 23
KK=JJ+K	DM21 24
6 THET(KK)=THET(K)	DM21 25
RETURN	DM21 26
END	DM21 27

	SUBROUTINE THKIN	0422	1
C		0422	2
C	VERSION: DEMON1	0422	3
C		0422	4
C	SUBROUTINE TO INPUT THICKNESS DATA.	0422	5
C		0422	6
	LOGICAL ASYMT	0422	7
	COMMON/THKDAT/NTDAT,NCWT,NTPP,MSWT(4),NRPT,NHPT,N3PT,ATHP,ASYMT,	0422	8
1	NVERT,SWLET(20,4),SWTET(20,4),YTH(20,4),THETAL(400)	0422	9
	COMMON/TSPANS/SPANR,SPANL,SPANU,SPAND,SWPLER,SWPLEL,SWPLEH,	0422	10
1	SWPLED,SWPTER,SWPTL,SWPTED,SWPTED,RRDD	0422	11
	COMMON/THIAS/NUMIS,THET(400)	0422	12
C		0422	13
	500 FORMAT(10I5)	0422	14
	510 FORMAT(3F10.0)	0422	15
C		0422	16
C		0422	17
C	INITIALIZE INDICES	0422	18
C		0422	19
	NLP=0	0422	20
	NUP=0	0422	21
	NDP=0	0422	22
C		0422	23
C	INPUT RIGHT WING DATA.	0422	24
C		0422	25
	READ(5,500) MSWT(1),LVSWT,NUMIS	0422	26
	MSWP=MSWT(1)+1	0422	27
C		0422	28
C	IF SIDESLIP IS NON=ZERO OR IF LVSWT=0, SPANWISE SPACINGS	0422	29
C	ARE NOT READ IN. THEY MUST BE CALCULATED AND EQUALLY	0422	30
C	SPACED. NO BREAKS IN SWEEP ARE ALLOWED.	0422	31
C		0422	32
	IF(ASYMT.OR.LVSWT.EQ.0) GO TO 5	0422	33
	READ(5,510) (YTH(I,1),SWLET(I,1),SWTET(I,1),I=1,MSWP)	0422	34
	GO TO 10	0422	35
	5 CALL EDGES(MSWP,SPANR,RRDD,SWPLER,SWPTER,YTH(1,1),SWLET(1,1),	0422	36
	1 SWTET(1,1))	0422	37
	10 CONTINUE	0422	38
C		0422	39
C	SUBROUTINE THETIN READS THICKNESS SLOPES.	0422	40
C		0422	41
	CALL THETIN(MSWT(1),NRPT)	0422	42
	DO 15 I=1,NRPT	0422	43
15	THETAL(I)=THET(I)	0422	44
	IF(NTDAT.EQ.1) GO TO 40	0422	45
C		0422	46
C	INPUT LEFT WING DATA IF SIDESLIP IS NON=ZERO, WING ALONE.	0422	47
C		0422	48
	IF(.NOT.ASYMT) GO TO 25	0422	49
	READ(5,500) MSWT(2),LVSWT,NUMIS	0422	50
	MSWP=MSWT(2)+1	0422	51
	CALL EDGES(MSWP,-SPANL,-RRDD,-SWPLEL,-SWPTL,YTH(1,2),	0422	52
1	SWLET(1,2),SWTET(1,2))	0422	53
	CALL THETIN(MSWT(2),NLP)	0422	54
	DO 20 I=1,NLP	0422	55
20	THETAL(I+NRPT)=THET(I)	0422	56
C		0422	57
C	INPUT UPPER WING DATA IF VERTICAL WINGS ARE PRESENT	0422	58
C	AND THEIR GEOMETRY IS DIFFERENT FROM HORIZONTAL WINGS.	0422	59
C	NOTE THAT NTDAT IS NOW NE 1.	0422	60
C		0422	61
	25 CONTINUE	0422	62
	IF(NVERT.EQ.0) GO TO 50	0422	63
	READ(5,500) MSWT(3),LVSWT,NUMIS	0422	64

MSWP=MSWT(3)+1	DM22	65
IF(ASYMT,OR,LVSWT,EO,0) GO TO 27	DM22	66
READ(5,510) (YTH(I,3),SWLET(I,3),SWTET(I,3),I=1,MSWP)	DM22	67
GO TO 28	DM22	68
27 CALL EDGES(MSWP,SPANU,HHOD,SWPLEU,SWPTEU,YTH(I,3),SWLET(I,3),	DM22	69
1 SWTET(I,3))	DM22	70
28 CONTINUE	DM22	71
CALL THETIN(MSWT(3),NUP)	DM22	72
DO 30 I=1,NUP	DM22	73
30 THETAL(NRPT+NLP+I)=THET(I)	DM22	74
	DM22	75
INPUT LOWER WING DATA IF SIDESLIP IS NON-ZERO, WING ALONE.	DM22	76
	DM22	77
IF(.NOT,ASYMT) GO TO 50	DM22	78
READ(5,500) MSWT(4),LVSWT,NUNIS	DM22	79
MSWP=MSWT(4)+1	DM22	80
CALL EDGES(MSWP,=SPANU,=HHOD,=SWPLEU,=SWPTEU,YTH(1,4),SWLET(1,4),	DM22	81
1 SWTET(1,4))	DM22	82
CALL THETIN(MSWT(4),NDP)	DM22	83
DO 35 I=1,NDP	DM22	84
35 THETAL(NRPT+NLP+NUP+I)=THET(I)	DM22	85
GO TO 50	DM22	86
	DM22	87
ALL DATA INPUT AT THIS POINT.	DM22	88
	DM22	89
SET UPPER WING EQUAL TO RIGHT WING IN SYMMETRIC	DM22	90
CASE (NTOAT=1 AND NVERT NE 0)	DM22	91
	DM22	92
40 CONTINUE	DM22	93
IF(NVERT,EO,0) GO TO 50	DM22	94
MSWT(3)=MSWT(1)	DM22	95
MSWP=MSWT(1)+1	DM22	96
DO 45 I=1,MSWP	DM22	97
YTH(I,3)=YTH(I,1)	DM22	98
SWLET(I,3)=SWLET(I,1)	DM22	99
45 SWTET(I,3)=SWTET(I,1)	DM22	100
NUP=NRPT	DM22	101
DO 46 I=1,NRPT	DM22	102
46 THETAL(NRPT+I)=THETAL(I)	DM22	103
	DM22	104
CALCULATE INDICES.	DM22	105
	DM22	106
50 CONTINUE	DM22	107
NRPT=NRPT+NLP	DM22	108
N3PT=NRPT+NUP	DM22	109
NTHP=N3PT+NDP	DM22	110
	DM22	111
RETURN	DM22	112
END	DM22	113
SUBROUTINE THKLYT(CRP,IL)	DM23	1
	DM23	2
VERSION: DEMUNI	DM23	3
	DM23	4
THIS ROUTINE LAYS OUT SOURCE PANELS ON A SINGLE WING SURFACE.	DM23	5
	DM23	6
DIMENSION NDP(3)	DM23	7
	DM23	8
COMMON/DNE/CIRC(250),DELTP(250),FN(250),PNLC(250),SWPPLE(250),	DM23	9
IS-PPTE(250),VNOR(250),XBAR(250),ZBAR(250),XCPT(250),YCPT(250),ZCPT	DM23	10

	2(250),XLF(250),XLH(250),XRF(250),XHB(250),YLC(250),YHC(250),ZLF(250)	DM23	11
	30),ZRF(250),ZLB(250),ZRH(250),SNT(125),CST(125),SNT2(125),CST2(125)	DM23	12
	4),IP(300),XHP(100),A,ALFA,ALFR,ARWING,H2,P2V,BETA,BETAH,CORST,	DM23	13
	5CUSALF,COSBET,CN,OX,EM,FHACH,RR,SINALF,SINREF,SLOPE,TLRNC,TIPY,	DM23	14
	6TOTLR,U,V,*,UCHK,VCHK,WCHK,WBIP,X,DUMY,Z,I,IF,II,J,MSWR,MSWL,MSWU,	DM23	15
	7MSWD,NBIP,NCRX,NCH,NDRAG,NHP,NRP,NRP,N3P,NOCPT,NOLINP,NOUT,NPANLS,	DM23	16
	8NPRESS,NRAP,AGYM,BODY,DELTA,NOSYM	DM23	17
	COMMON/THKDAT/NTDAT,NCWT,NTPR,N3WT(4),NRPT,NHPT,N3PT,NTHP,ASYMT,	DM23	18
	1 NVERT,SWLET(20,4),SWTET(20,4),YTH(20,4),THETA(400)	DM23	19
	COMMON/THKPAN/XRFT(400),XLEFT(400),XRF(400),XLB(400),	DM23	20
	1 YRFT(400),YLCT(400),ZRF(400),ZLEFT(400),ZRB(400),	DM23	21
	2 ZLRT(400),SLLET(400),SLTET(400)	DM23	22
	LOGICAL LEFT	DM23	23
	DATA UTOR/,0174532925/	DM23	24
C		DM23	25
C	FORMAT STATEMENTS	DM23	26
C		DM23	27
	700 FORMAT(1H,30X,40HPANEL CORNER COORDINATES FOR WING PANELS)	DM23	28
	705 FORMAT(/,5X,1HJ,15X,2HLF,15X,1H*,12X,2HLB,15X,1H*,12X,2HRF,15X,	DM23	29
	1 1H*,12X,2HRB/12X,1H*,9X,1HY,9X,1HZ,5X,1H*,3X,1HX,9X,1HY,	DM23	30
	2 9X,1HZ,5X,1H*,3X,1HX,9X,1HY,9X,1HZ,5X,1H*,3X,1HX,9X,1HY,	DM23	31
	3 9X,1HZ,13X,1H*,29X,1H*,29X,1H*/130(1H*)/	DM23	32
	4 38X,1H*,29X,1H*,29X,1H*)	DM23	33
	710 FORMAT(/,1X,56(1H=),17HRIGHT WING PANELS,57(1H=)/)	DM23	34
	711 FORMAT(/,1X,57(1H=),16HLEFT WING PANELS,57(1H=)/)	DM23	35
	712 FORMAT(/,1X,56(1H=),17HUPPER WING PANELS,57(1H=)/)	DM23	36
	713 FORMAT(/,1X,56(1H=),17HLOWER WING PANELS,57(1H=)/)	DM23	37
	720 FORMAT(3X,15,3X,F9.4,1X,F9.4,1X,F9.4,1H*,F9.4,1X,F9.4,1X,F9.4,	DM23	38
	1 1H*,F9.4,1X,F9.4,1X,F9.4,1H*,F9.4,1X,F9.4,1X,F9.4)	DM23	39
C		DM23	40
C	VERTICAL WING COORDINATES ARE CALCULATED IN THE SAME WAY	DM23	41
C	AS HORIZONTAL COORDINATES. Y AND Z COORDINATES ARE	DM23	42
C	THEN INTERCHANGED FOR VERTICAL WING.	DM23	43
C	LEFT STANDS FOR EITHER LEFT HORIZONTAL WING	DM23	44
C	OR LOWER VERTICAL WING.	DM23	45
C		DM23	46
	LEFT=IL,EQ,1,OR,IL,EQ,3	DM23	47
	NS=IL+1	DM23	48
	NRP(1)=NRPT	DM23	49
	NRP(2)=NHPT	DM23	50
	NRP(3)=N3PT	DM23	51
	MSWP=MSWT(NS)+1	DM23	52
C		DM23	53
C	SET CONSTANT SWEEP INDICATOR.	DM23	54
C		DM23	55
	LVSWT=0	DM23	56
	IF(MSWP,EQ,2) GO TO 15	DM23	57
	DO 10 I=3,MSWP	DM23	58
	IM=I-1	DM23	59
	10 IF(SWLET(I,NS),NE,SWLET(IM,NS),OR,SWTET(I,NS),NE,SWTET(IM,NS))	DM23	60
	1 LVSWT=1	DM23	61
	15 SLPWLE=TAN(SWLET(MSWP,NS)*OT(H)	DM23	62
	SLPWE=TAN(SWTET(MSWP,NS)*UTOR)	DM23	63
	CSIDE=CRP	DM23	64
	ANCA=NCWT	DM23	65
	ALFX=0.0	DM23	66
C		DM23	67
C	LAY OUT PANELS. INDEX I RUNS SPANWISE, K CHORDWISE.	DM23	68
C		DM23	69
C	CALCULATE OUTWARD SIDE EDGE FOR A CHORDWISE ROW.	DM23	70
C		DM23	71
	DO 60 I=2,MSWP	DM23	72
	IM=I-1	DM23	73
	15 (LVSWT,EQ,0) GO TO 20	DM23	74

SLP=LE*TAN(SWLET(I,NS)*DTOR)	DM23 75
SLPWTE=TAN(SWTET(I,NS)*DTOR)	DM23 76
20 SLPDIF=SLP*LE-SLPWTE	DM23 77
CSIDE=CSIDEP-(YTH(I,NS)-YTH(IM,NS))*SLPDIF	DM23 78
IF(I,EQ,2) GO TO 30	DM23 79
JLE=(I-3)*NCWT+1	DM23 80
IF(NS,GT,1) JLE=JLE+NDP(NS-1)	DM23 81
WLEX=XRFT(JLE)	DM23 82
IF(LEFT) WLEX=XLFT(JLE)	DM23 83
30 CONTINUE	DM23 84
C CALCULATE PANEL LEADING AND TRAILING EDGE	DM23 85
C SLOPES AND CORNER COORDINATES.	DM23 86
C	DM23 87
DO 50 K=1,NCWT	DM23 88
J=(I-2)*NCWT+K	DM23 89
IF(NS,GT,1) J=J+NDP(NS-1)	DM23 90
AKM=K-1	DM23 91
AKM	DM23 92
SLLET(J)=SLPWLE-AKM*SLPDIF/ANCW	DM23 93
SLTET(J)=SLPWLE-AKM*SLPDIF/ANCW	DM23 94
IF (ABS(SLLET(J)),LE,0.001) SLLET(J)=0.0	DM23 95
IF (ABS(SLTET(J)),LE,0.001) SLTET(J)=0.0	DM23 96
XLFT(J)=AKM*CSIDEP/ANCW+WLEX	DM23 97
XLBT(J)=XLFT(J)+CSIDEP/ANCW	DM23 98
XRFT(J)=AKM*CSIDE/ANCW+(YTH(I,NS)-YTH(IM,NS))*SLPWLE+WLEX	DM23 99
XRBT(J)=XRFT(J)+CSIDE/ANCW	DM23 100
YLCT(J)=YTH(IM,NS)	DM23 101
YRCT(J)=YTH(I,NS)	DM23 102
IF(.NOT.LEFT) GO TO 40	DM23 103
C INTERCHANGE LEFT AND RIGHT COORDINATES FOR LEFT WING.	DM23 104
C	DM23 105
TEMP=XLFT(J)	DM23 106
XLFT(J)=XRFT(J)	DM23 107
XRFT(J)=TEMP	DM23 108
TEMP=XLBT(J)	DM23 109
XLBT(J)=XRBT(J)	DM23 110
XRBT(J)=TEMP	DM23 111
TEMP=YLCT(J)	DM23 112
YLCT(J)=YRCT(J)	DM23 113
YRCT(J)=TEMP	DM23 114
IF (SLLET(J),EQ,0.0) SLLET(J)=TLRNC	DM23 115
IF (SLTET(J),EQ,0.0) SLTET(J)=TLRNC	DM23 116
C	DM23 117
40 CONTINUE	DM23 118
ZLFT(J)=0.0	DM23 119
ZRFT(J)=0.0	DM23 120
ZLBT(J)=0.0	DM23 121
ZRBT(J)=0.0	DM23 122
C INTERCHANGE Y AND Z COORDINATES FOR VERTICAL PANELS.	DM23 123
C	DM23 124
IF(NS,LE,2) GO TO 50	DM23 125
ZLFT(J)=YLCT(J)	DM23 126
ZLBT(J)=YLCT(J)	DM23 127
YLCT(J)=0.0	DM23 128
ZRFT(J)=YRCT(J)	DM23 129
ZRBT(J)=YRCT(J)	DM23 130
YRCT(J)=0.0	DM23 131
50 CONTINUE	DM23 132
CSIDEP=CSIDE	DM23 133
	DM23 134
	DM23 135
	DM23 136
	DM23 137



60	CONTINUE		
C			DM23 138
C	DEBUG PRINT OF PANEL CORNER COORDINATES.		DM23 139
C			DM23 140
	IF(NTPR.EQ.0) RETURN		DM23 141
	IF(IL.GT.0) GO TO 70		DM23 142
	WRITE(6,700)		DM23 143
	WRITE(6,705)		DM23 144
	WRITE(6,710)		DM23 145
	N1=1		DM23 146
	NF=NRPT		DM23 147
	GO TO 90		DM23 148
70	IF(IL.GT.1) GO TO 75		DM23 149
	WRITE(6,711)		DM23 150
	N1=NHPT+1		DM23 151
	NF=NHPT		DM23 152
	GO TO 90		DM23 153
75	IF(IL.EQ.3) GO TO 80		DM23 154
	WRITE(6,712)		DM23 155
	N1=NHPT+1		DM23 156
	NF=N3PT		DM23 157
	GO TO 90		DM23 158
80	WRITE(6,713)		DM23 159
	N1=N3PT+1		DM23 160
	NF=NTHP		DM23 161
90	WRITE(6,720) (J,XLEFT(J),YLCT(J),ZLFT(J),XLBT(J),VLCT(J),ZLBT(J),		DM23 162
	1 XRT(J),YRCT(J),ZHFT(J),XRHT(J),YHCT(J),ZHBT(J),J=N1,NF)		DM23 163
C			DM23 164
	RETURN		DM23 165
	END		DM23 166
			DM23 167

	SUBROUTINE THKOUT		DM24 1
C			DM24 2
C	VERSION: DEMON1		DM24 3
C			DM24 4
C	THIS ROUTINE PRINTS OUT THICKNESS DATA. AFTER THE		DM24 5
C	THICKNESS SLOPES ARE PRINTED, THEY ARE DIVIDED BY PI.		DM24 6
C			DM24 7
	LOGICAL ASYMT		DM24 8
	COMMON/THKDAT/NTDAT,NCMT,NTPR,MSWT(4),NRPT,NHPT,N3PT,NTHP,ASYMT,		DM24 9
	1 NVERT,SWLET(20,4),SWTET(20,4),YTH(20,4),THETAL(400)		DM24 10
	DATA PI/3.141592654/		DM24 11
C			DM24 12
600	FORMAT(1H1,30X,56HINPUT VALUES OF THE LOCAL SURFACE SLOPE OF THE		DM24 13
	THICKNESS/32X,52H0ISTRIBUTION, FOR EACH CHORDWISE ROW THE FIRST VAL		DM24 14
	2HE/37X,41HIS FOR THE PANEL NEAREST THE LEADING EDGE)		DM24 15
610	FORMAT( //5X,18HRIGHT WING SURFACE/)		DM24 16
620	FORMAT( //5X,17HLEFT WING SURFACE/)		DM24 17
630	FORMAT( //5X,18HUPPER WING SURFACE/)		DM24 18
640	FORMAT( //5X,18HLOWER WING SURFACE/)		DM24 19
650	FORMAT(11X,3HRIW,30X,6HSLOPES)		DM24 20
660	FORMAT(8X,15,4X,(//1H+,27X,8F10,5))		DM24 21
670	FORMAT(1H1,26H WING THICKNESS INPUT DATA///15X,		DM24 22
	1 55HSPANWISE LOCATIONS OF PANEL SIDE EDGES AND SWEEP ANGLES/		DM24 23
	2 20X,27HOF WING SECTION TO THE LEFT,//26X,		DM24 24
	3 29HSPANWISE LE SWEEP TE SWEEP/20X,1HT,5X,8HLOCATION/		DM24 25
	4 28X,4HFET,5X,7HDEGREES,3X,7HDEGREES)		DM24 26
675	FORMAT(18X,15,4X,3F10,5)		DM24 27
680	FORMAT(//16X,13,36H THICKNESS PANELS ARE TO BE LAID OUT/18X,13,		DM24 28
	1 20H CHORDWISE ROWS 41TH,13,12H IN EACH ROW)		DM24 29

C		DM24	30
C	----- OUTPUT THICKNESS PANEL GEOMETRY -----	DM24	31
C		DM24	32
C	HEADING AND RIGHT WING DATA	DM24	33
C		DM24	34
	WRITE(6,670)	DM24	35
	WRITE(6,610)	DM24	36
	NSP=MSWT(1)+1	DM24	37
	WRITE(6,675) (I,YTH(I,1),SWLET(I,1),SWTET(I,1),I=1,NSP)	DM24	38
	WRITE(6,680) NRPT,MSWT(1),NCWT	DM24	39
C		DM24	40
C	LEFT WING DATA IF NON-ZERO SIDESLIP AND WING ALONE.	DM24	41
C		DM24	42
	IF(.NOT.ASYM) GO TO 2	DM24	43
	WRITE(6,620)	DM24	44
	NSP=MSWT(2)+1	DM24	45
	WRITE(6,675) (I,YTH(I,2),SWLET(I,2),SWTET(I,2),I=1,NSP)	DM24	46
	NLFT=NRPT	DM24	47
	WRITE(6,680) NLFT,MSWT(2),NCWT	DM24	48
C		DM24	49
C	UPPER WING DATA IF VERTICAL WINGS PRESENT	DM24	50
C		DM24	51
	2 CONTINUE	DM24	52
	IF(NVERT.EQ.0) GO TO 4	DM24	53
	WRITE(6,630)	DM24	54
	NSP=MSWT(3)+1	DM24	55
	WRITE(6,675) (I,YTH(I,3),SWLET(I,3),SWTET(I,3),I=1,NSP)	DM24	56
	NUPP=NRPT	DM24	57
	WRITE(6,680) NUPP,MSWT(3),NCWT	DM24	58
C		DM24	59
C	LOWER WING DATA IF NON-ZERO SIDESLIP AND WING ALONE.	DM24	60
C		DM24	61
	IF(.NOT.ASYM) GO TO 4	DM24	62
	WRITE(6,640)	DM24	63
	NSP=MSWT(4)+1	DM24	64
	WRITE(6,675) (I,YTH(I,4),SWLET(I,4),SWTET(I,4),I=1,NSP)	DM24	65
	NBP=NRPT	DM24	66
	WRITE(6,680) NBP,MSWT(4),NCWT	DM24	67
C		DM24	68
C	----- OUTPUT THICKNESS SLOPES -----	DM24	69
C		DM24	70
	4 CONTINUE	DM24	71
C		DM24	72
C	HEADING AND RIGHT WING DATA	DM24	73
C		DM24	74
	WRITE(6,600)	DM24	75
	WRITE(6,610)	DM24	76
	WRITE(6,650)	DM24	77
	MNE0	DM24	78
	I=0	DM24	79
	DO 5 JNW=1, NRPT, NCWT	DM24	80
	MNEMN=NCWT	DM24	81
	I=I+1	DM24	82
	WRITE(6,660) I, (THETA(J), J=JNW, MN)	DM24	83
	5 CONTINUE	DM24	84
C		DM24	85
C	LEFT WING DATA IF NON-ZERO SIDESLIP AND WING ALONE	DM24	86
C		DM24	87
	IF(.NOT.ASYM) GO TO 20	DM24	88
	WRITE(6,620)	DM24	89
	WRITE(6,650)	DM24	90
	IB0	DM24	91
	NBP=NRPT+1	DM24	92

DD 10 JN=NRPP,NHPT,NCWT	DM24 93
MN=MN+NCWT	DM24 94
I=I+1	DM24 95
WRITE(6,660) I,(THETA(J),J=JNW,MN)	DM24 96
10 CONTINUE	DM24 97
C	DM24 98
C UPPER WING DATA IF VERTICAL WINGS PRESENT	DM24 99
C	DM24 100
20 CONTINUE	DM24 101
IF(NVERT.EQ.0) GO TO 40	DM24 102
WRITE(6,630)	DM24 103
WRITE(6,650)	DM24 104
I=0	DM24 105
NHPP=NHPT+1	DM24 106
DD 25 JN=NHPP,N3PT,NCWT	DM24 107
MN=MN+NCWT	DM24 108
I=I+1	DM24 109
WRITE(6,660) I,(THETA(J),J=JNW,MN)	DM24 110
25 CONTINUE	DM24 111
C	DM24 112
C LOWER WING DATA IF NON-ZERO SIDESLIP AND WING ALONE.	DM24 113
C	DM24 114
IF(.NOT. ASYMT) GO TO 40	DM24 115
WRITE(6,640)	DM24 116
WRITE(6,650)	DM24 117
I=0	DM24 118
N3PP=N3PT+1	DM24 119
DD 30 JN=N3PP,NTHP,NCWT	DM24 120
MN=MN+NCWT	DM24 121
I=I+1	DM24 122
WRITE(6,660) I,(THETA(J),J=JNW,MN)	DM24 123
30 CONTINUE	DM24 124
C	DM24 125
C DIVIDE INPUT SLOPES BY PI	DM24 126
C	DM24 127
40 CONTINUE	DM24 128
DD 45 J=1,NTHP	DM24 129
45 THETA(J)=THETA(J)/PI	DM24 130
C	DM24 131
RETURN	DM24 132
END	DM24 133
SUBROUTINE THKVEL(XX,YY,ZZ)	DM25 1
C	DM25 2
C	DM25 3
C VERSION: DEMON1	DM25 4
C	DM25 5
C THIS SUBROUTINE CALCULATES PERTURBATION VELOCITIES INDUCED BY	DM25 6
C THE WING THICKNESS PANELS.	DM25 7
C SUPERPOSITION OF 4 CORNER SOLUTIONS IS USED.	DM25 8
C THKVEL RETURNS VELOCITIES UTH,VTH,WTH IN WING	DM25 9
C REFERENCE FRAME.	DM25 10
C	DM25 11
C LOGICAL NUPR,SIDSLIP,VERPNL	DM25 12
C	DM25 13
COMMON/THKDAT/UTDAT,NCWT,NTPR,MSWT(4),NRPT,NHPT,N3PT,NTHP,SIDSLIP,	DM25 14
1 NVERT,SHLET(20,4),SHLET(20,4),YTH(20,4),THETA(400)	DM25 15
COMMON/THKPAN/XHET(400),XLET(400),XRRT(400),XLHT(400),	DM25 16
1 YRCT(400),YLCT(400),ZHET(400),ZLET(400),ZRHT(400),	DM25 17
2 ZLHT(400),SLLET(400),SLTET(400)	DM25 18

COMMON/ICVEL/UMPT,VPT,WPT,IIT,IFT,4J	DM25	19
COMMON/THVARG/X,Y,Z,U,V,W,EM,VERPNL,NOPR	DM25	20
C	DM25	21
1 FORMAT(5X,5HPANEL,14,4X,6HCORNER,12,	DM25	22
1	DM25	23
1,3X,4HZ = F12.5/6X,4HU = F12.5/6X,4HV = F12.5/6X,4HW = F12.5/6X,	DM25	24
2 5X,5HTU = F12.5,5X,5HTV = F12.5,5X,5HTW = F12.5)	DM25	25
2 FORMAT(///6H UPT = F12.5,5X,5HVT = F12.5,5X,5HWT = F12.5)	DM25	26
C	DM25	27
NOPTENTPR,NE,0	DM25	28
C	DM25	29
UPT=0.0	DM25	30
VPT=0.0	DM25	31
WPT=0.0	DM25	32
XI=XX	DM25	33
VI=VV	DM25	34
ZI=ZZ	DM25	35
C	DM25	36
I IS INDEX OF INFLUENCING PANEL	DM25	37
C	DM25	38
DO 100 I=IIT,IFT	DM25	39
VERPNL=I,GT,NHPT	DM25	40
MI=I	DM25	41
TU=0.	DM25	42
TV=0.	DM25	43
TW=0.	DM25	44
EM1=SLLET(I)	DM25	45
EM2=SLTET(I)	DM25	46
C	DM25	47
C***** CORNER 1 *****	DM25	48
C	DM25	49
C	DM25	50
IF(EM1,LT,0.0) GO TO 15	DM25	51
EM=EM1	DM25	52
X=XI-XLFT(I)	DM25	53
Y=YI-YLCT(I)	DM25	54
Z=ZI-ZLFT(I)	DM25	55
CALL VELOTH	DM25	56
TU=TU+U	DM25	57
TV=TV+V	DM25	58
TW=TW+W	DM25	59
ICNR=1	DM25	60
MNJ=MI	DM25	61
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM25	62
IF(SOSLIP) GO TO 10	DM25	63
IF (VERPNL) GO TO 31	DM25	64
V=(VI+YLCT(I))	DM25	65
CALL VELOTH	DM25	66
TU=TU+U	DM25	67
TV=TV+V	DM25	68
TW=TW+W	DM25	69
GO TO 32	DM25	70
31 Z=(ZI+ZLFT(I))	DM25	71
CALL VELOTH	DM25	72
TU=TU+U	DM25	73
TV=TV+V	DM25	74
TW=TW+W	DM25	75
32 CONTINUE	DM25	76
MNJ=MI	DM25	77
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM25	78
GO TO 10	DM25	79
C	DM25	80
C CORNER 1 FOR W,LT,0.0	DM25	81

C		0425	82
15	CONTINUE	0425	83
	EM=EM1	0425	84
	X=XI-XLFT(I)	0425	85
	Y=YLCT(I)-YI	0425	86
	Z=ZI-ZLFT(I)	0425	87
	IF(VERPNL) GO TO 51	0425	88
	CALL VELOTH	0425	89
	TU=TI-U	0425	90
	TV=TV+V	0425	91
	TW=TW+W	0425	92
	GO TO 52	0425	93
51	V=-Y	0425	94
	Z=-Z	0425	95
	CALL VELOTH	0425	96
	TU=TI-U	0425	97
	TV=TV+V	0425	98
	TW=TW+W	0425	99
52	CONTINUE	0425	100
	ICNR=1	0425	101
	MNJ=MJ	0425	102
	IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	0425	103
	IF(SDSLIP) GO TO 17	0425	104
	IF(VERPNL) GO TO 41	0425	105
	Y=YLCT(I)+YI	0425	106
	CALL VELOTH	0425	107
	TU=TI-U	0425	108
	TV=TV+V	0425	109
	TW=TW+W	0425	110
	GO TO 42	0425	111
C		0425	112
41	Z=ZLFT(I)+ZI	0425	113
	CALL VELOTH	0425	114
	TU=TI-U	0425	115
	TV=TV+V	0425	116
	TW=TW+W	0425	117
42	CONTINUE	0425	118
	MNJ=MJ	0425	119
	IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	0425	120
	GO TO 17	0425	121
10	CONTINUE	0425	122
C		0425	123
C	***** CORNER 2 *****	0425	124
C		0425	125
	X=XI-XRFT(I)	0425	126
	Y=YI-YRCT(I)	0425	127
	Z=ZI-ZRFT(I)	0425	128
	CALL VELOTH	0425	129
	TU=TI-U	0425	130
	TV=TV+V	0425	131
	TW=TW+W	0425	132
	ICNR=2	0425	133
	MNJ=MJ	0425	134
	IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	0425	135
	IF(SDSLIP) GO TO 20	0425	136
	IF(VERPNL) GO TO 33	0425	137
	Y=(YI+YRCT(I))	0425	138
	CALL VELOTH	0425	139
	TU=TI-U	0425	140
	TV=TV+V	0425	141
	TW=TW+W	0425	142
	GO TO 34	0425	143
33	Z=(ZI+ZRFT(I))	0425	144
	CALL VELOTH	0425	145

TU=TV=U	0425 146
TV=TV=V	0425 147
TW=TW+W	0425 148
34 CONTINUE	0425 149
MNJ=MJ	0425 150
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	0425 151
GO TO 20	0425 152
C	0425 153
C CORNER 2 FOR M.LT. 0	0425 154
C	0425 155
17 CONTINUE	0425 156
X=XI-XRFT(I)	0425 157
Y=YRFT(I)-YI	0425 158
Z=ZI-ZRFT(I)	0425 159
IF(VERPNL) GO TO 53	0425 160
CALL VELOTH	0425 161
TU=TV=U	0425 162
TV=TV=V	0425 163
TW=TW+W	0425 164
GO TO 54	0425 165
53 Y=Y	0425 166
Z=Z	0425 167
CALL VELOTH	0425 168
TU=TV=U	0425 169
TV=TV=V	0425 170
TW=TW+W	0425 171
54 CONTINUE	0425 172
ICNR=2	0425 173
MNJ=MJ	0425 174
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	0425 175
IF(SOSLIP) GO TO 20	0425 176
IF(VERPNL) GO TO 43	0425 177
Y=YRFT(I)+YI	0425 178
CALL VELOTH	0425 179
TU=TV=U	0425 180
TV=TV=V	0425 181
TW=TW+W	0425 182
GO TO 44	0425 183
43 Z=ZRFT(I)+ZI	0425 184
CALL VELOTH	0425 185
TU=TV=U	0425 186
TV=TV=V	0425 187
TW=TW+W	0425 188
44 CONTINUE	0425 189
MNJ=MJ	0425 190
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	0425 191
20 CONTINUE	0425 192
C	0425 193
C***** CORNER 3 *****	0425 194
C	0425 195
IF(EM2.LT.0.0) GO TO 19	0425 196
EM=EM2	0425 197
X=XI-XLRT(I)	0425 198
Y=YI-YLCT(I)	0425 199
Z=ZI-ZLRT(I)	0425 200
CALL VELOTH	0425 201
TU=TV=U	0425 202
TV=TV=V	0425 203
TW=TW+W	0425 204
ICNR=3	0425 205
MNJ=MJ	0425 206
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	0425 207
IF(SOSLIP) GO TO 30	0425 208

IF (VERPNL) GO TO 35	DM25 209
Y=-(YI+VLCT(I))	DM25 210
CALL VELOTH	DM25 211
TU=TU+U	DM25 212
TV=TV+V	DM25 213
TW=TW+W	DM25 214
GO TO 36	DM25 215
35 Z=-(ZI+ZLRT(I))	DM25 216
CALL VELOTH	DM25 217
TU=TU+U	DM25 218
TV=TV+V	DM25 219
TW=TW+W	DM25 220
36 CONTINUE	DM25 221
MNJ=MJ	DM25 222
IF (NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM25 223
GO TO 30	DM25 224
C	DM25 225
C	DM25 226
C	DM25 227
19 CONTINUE	DM25 228
EM=EM2	DM25 229
X=XI-XLRT(I)	DM25 230
Y=VLCT(I)+YI	DM25 231
Z=ZI-ZLRT(I)	DM25 232
IF (VERPNL) GO TO 55	DM25 233
CALL VELOTH	DM25 234
TU=TU+U	DM25 235
TV=TV+V	DM25 236
TW=TW+W	DM25 237
GO TO 56	DM25 238
55 Y=-Y	DM25 239
Z=-Z	DM25 240
CALL VELOTH	DM25 241
TU=TU+U	DM25 242
TV=TV+V	DM25 243
TW=TW+W	DM25 244
56 CONTINUE	DM25 245
ICNR=3	DM25 246
MNJ=MJ	DM25 247
IF (NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM25 248
IF (SDSLIP) GO TO 21	DM25 249
IF (VERPNL) GO TO 45	DM25 250
Y=VLCT(I)+YI	DM25 251
CALL VELOTH	DM25 252
TU=TU+U	DM25 253
TV=TV+V	DM25 254
TW=TW+W	DM25 255
GO TO 46	DM25 256
45 Z=ZLRT(I)+ZI	DM25 257
CALL VELOTH	DM25 258
TU=TU+U	DM25 259
TV=TV+V	DM25 260
TW=TW+W	DM25 261
46 CONTINUE	DM25 262
MNJ=MJ	DM25 263
IF (NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM25 264
GO TO 21	DM25 265
30 CONTINUE	DM25 266
C	DM25 267
C ***** CORNER 4 *****	DM25 268
C	DM25 269
Y=XI-YRRT(I)	DM25 270
V=YI-YRCT(I)	DM25 271
Z=ZI-ZPRT(I)	DM25 272

CALL VELOTH	DM25 273
TU=TV+U	DM25 274
TV=TV+V	DM25 275
T=TW+W	DM25 276
ICNR=4	DM25 277
MNJ=MJ	DM25 278
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM25 279
IF(SDSLIP) GO TO 40	DM25 280
IF(VERPNL) GO TO 37	DM25 281
Y=VI+YRCT(I)	DM25 282
CALL VELOTH	DM25 283
TU=TV+U	DM25 284
TV=TV+V	DM25 285
T=TW+W	DM25 286
GO TO 38	DM25 287
37 Z=ZI+ZRRT(I)	DM25 288
CALL VELOTH	DM25 289
TU=TV+U	DM25 290
TV=TV+V	DM25 291
T=TW+W	DM25 292
38 CONTINUE	DM25 293
MNJ=MJ	DM25 294
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM25 295
GO TO 40	DM25 296
C	DM25 297
C	DM25 298
C	DM25 299
21 CONTINUE	DM25 300
X=XI-XRRT(I)	DM25 301
Y=YRCT(I)-YI	DM25 302
Z=ZI-ZRRT(I)	DM25 303
IF(VERPNL) GO TO 57	DM25 304
CALL VELOTH	DM25 305
TU=TV+U	DM25 306
TV=TV+V	DM25 307
T=TW+W	DM25 308
GO TO 58	DM25 309
57 Y=V	DM25 310
Z=Z	DM25 311
CALL VELOTH	DM25 312
TU=TV+U	DM25 313
TV=TV+V	DM25 314
T=TW+W	DM25 315
58 CONTINUE	DM25 316
ICNR=4	DM25 317
MNJ=MJ	DM25 318
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM25 319
IF(SDSLIP) GO TO 40	DM25 320
IF(VERPNL) GO TO 47	DM25 321
Y=VI+YRCT(I)	DM25 322
CALL VELOTH	DM25 323
TU=TV+U	DM25 324
TV=TV+V	DM25 325
T=TW+W	DM25 326
GO TO 48	DM25 327
47 Z=ZRRT(I)+ZI	DM25 328
CALL VELOTH	DM25 329
TU=TV+U	DM25 330
TV=TV+V	DM25 331
T=TW+W	DM25 332



4A	CONTINUE	DM25	333
	MNJ=-MJ	DM25	334
	IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TS	DM25	335
4B	CONTINUE	DM25	336
C		DM25	337
	UPT=UPT+TU*THEAL(I)	DM25	338
	VPT=VPT+TV*THEAL(I)	DM25	339
	WPT=WPT+TW*THEAL(I)	DM25	340
100	CONTINUE	DM25	341
C		DM25	342
	IF(NOPR) WRITE(6,2) UPT,VPT,WPT	DM25	343
C		DM25	344
	RETURN	DM25	345
	END	DM25	346
	SUBROUTINE TRHIP(YI,ZI,YO,ZO,I)	DM26	1
C		DM26	2
C	VERSION: DEMON1	DM26	3
C		DM26	4
C	THIS SUBROUTINE TRANSFORMS COORDINATES AND VELOCITIES FROM WING	DM26	5
C	COORDINATE SYSTEM TO INTERFERENCE PANEL COORDINATE SYSTEM AND	DM26	6
C	VICE VERSA.	DM26	7
C		DM26	8
	LOGICAL ASYM,BODY,DELTA,NOSYM	DM26	9
C		DM26	10
	COMMON/ONE/DUM1(5500),SNT(125),CST(125),SNT2(125),CST2(125),	DM26	11
	IIP(300),YFBIP(100),DUM2(12),DX,DUM3(2),RH,DUM4(12),WHIP,DUM5(11),	DM26	12
	ZHBIP,DUM6(10),NPANLS,NPRESS,NWHP,ASYM,BODY,DELTA,NOSYM	DM26	13
C		DM26	14
	DIMENSION YLC(250),ZLF(250)	DM26	15
	EQUIVALENCE (YLC(1),DUM1(4001)), (ZLF(1),DUM1(4501))	DM26	16
C		DM26	17
C	TRANSFORM FROM BIP TO WING COORDINATES	DM26	18
C		DM26	19
	INP=I+NPANLS	DM26	20
	YO=YI*CST2(I) + ZI*SNT2(I) + YLC(INP)	DM26	21
	ZO=ZI*CST2(I) - YI*SNT2(I) + ZLF(INP)	DM26	22
	RETURN	DM26	23
C		DM26	24
C	TRANSFORM FROM WING TO BIP COORDINATES	DM26	25
C		DM26	26
	ENTRY TRWHIP	DM26	27
	INP=I+NPANLS	DM26	28
	ZC=ZI-ZLF(INP)	DM26	29
	YC=YI-YLC(INP)	DM26	30
10	YO=YC+CST2(I) - ZC*SNT2(I)	DM26	31
	ZO=ZC+CST2(I) + YC*SNT2(I)	DM26	32
	RETURN	DM26	33
C		DM26	34
C	VELOCITY TRANSFORM == BIP TO WING	DM26	35
C		DM26	36
	ENTRY ROTH	DM26	37
	YO=YI*CST2(I) + ZI*SNT2(I)	DM26	38
	ZO=ZI*CST2(I) - YI*SNT2(I)	DM26	39
	RETURN	DM26	40
C		DM26	41
C	WING TO BIP VELOCITY TRANSFORM	DM26	42
C		DM26	43
	ENTRY ROTWH	DM26	44
	ZC=ZI	DM26	45
	YC=YI	DM26	46

GO TO 10  
END

0426 47  
0426 48

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SUBROUTINE VELCAL(NDIM,ALPHA,BETA,NSTART)      0427 1
C
C VERSION: DEMON1                             0427 2
C
C SUBROUTINE TO CALCULATE THE VELOCITIES FOR THE FIELD POINTS X,Y,Z DUE 0427 3
C TO THE BODY SINGULARITIES.                  0427 4
C
C
C DIMENSION X(150),YY(150),ZZ(150)           0427 5
C
C LOGICAL ASYM,BODY,DELTA,NOSYM               0427 6
C
C COMMON/ONE/CIRC(250),DUM1(500),PNLC(250),DUM2(500),VWNR(250), 0427 7
C 1XPAR(250),ZHAR(250),DUMH(750),          DUM3(2500),DUM4(904), 0427 8
C 2H2,H2V,DUM5(5),CN,DUM6(24),MSWR,MSWL,MSWU,MSWD,DUM7(2),NCV,NDRAG, 0427 9
C 3HWP,NWP,NRP,N3P,DUM8(6),ASYM,BODY,DELTA,NOSYM 0427 10
C COMMON/TAO/TX(101),DU49(505),DUMZZ(403),T(100),TC(100),COEFF(5), 0427 11
C 1RCODE,BETASQ,BSD,RADIUS,RFIELD,RNOSE,U,V,VT,XA,XB,XC,XD,XFIELD,X2, 0427 12
C 2LBODY,NXBODY 0427 13
C COMMON/RVEL/BI(150),VI(150),WI(150),XFLOP(150),YFLOP(150), 0427 14
C 1ZFLOP(150) 0427 15
C COMMON/WATH/THTI(125),X*LE 0427 16
C
C
C REAL LBODY 0427 17
C INTEGER BCODE 0427 18
C
C
C TRANSFORM X-COORDINATES INTO THE BODY SYSTEM 0427 19
C
C DO 50 K=NSTART,NDIM 0427 20
C X(K)=XFLOP(K)+X*LE 0427 21
C YY(K)=YFLOP(K) 0427 22
C 50 ZZ(K)=ZFLOP(K) 0427 23
C N=NXBODY+1 0427 24
C
C CALCULATION OF COORDINATE ROTATION ANGLE. 0427 25
C
C IF (ABS(ALPHA).LT.1.0E-04) GO TO 51 0427 26
C PHI=ATAN(BETA/ALPHA) 0427 27
C GO TO 52 0427 28
C 51 PHI=0.0 0427 29
C 52 CONTINUE 0427 30
C
C CALCULATION OF VELOCITIES. 0427 31
C
C
C NOTE: FOR A ROLLED CONFIGURATION,ANGLE THPLPH EQUALS ROLL ANGLE PHI 0427 32
C PLUS ANGLE THETA(ZB TO YB) ASSOCIATED WITH THE BODY COORDINATE 0427 33
C SYSTEM. 0427 34
C
C DO 100 I=NSTART,NDIM 0427 35
C
C
C XFIELD=X(I) 0427 36
C YFIELD=SQRT(YY(I)**2+ZZ(I)**2) 0427 37
C THETA=ATAN2(YY(I),ZZ(I)) 0427 38
C THPLPH=THETA+PHI 0427 39

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      NSQ=HETASQ+RFIELD*RFIELD
      XZ=XFIELD*LBODY
C
      US=0.
      VS=0.
      UD=0.
      VD=0.
      VTD=0.
      DO 110 J=1,N
      CALL SOURCE(J)
      US=US+T(J)*U
      VS=VS+T(J)*V
      CALL ORUCLT(J)
      UD=UD+U*TC(J)
      VD=VD+V*TC(J)
      110 VTD=VTD+VT*TC(J)
C
C TRANSFORMATION OF VELOCITIES INTO BODY COORDINATE SYSTEM.
C U,V,W, RATHER THAN U,VR,VTHETA.
C
      COSTH=COS(THPLPH)
      U1(I)=US+UD*COSTH
      VR=VD*COSTH+VS
      VTD=VTD*SIN(THPLPH)
      SINTH=SIN(THETA)
C
C AT THIS STAGE U1,VR,VTD ARE THE LONGITUDINAL,RADIAL AND TANGENTIAL
C VELOCITY COMPONENTS IN THE BODY CYLINDRICAL COORDINATE SYSTEM.
C NEXT,TRANSFORM INTO RECTANGULAR BODY COORDINATE SYSTEM.
C
      COSTH=COS(THETA)
      V1(I)=VR*SINTH+VTD*COSTH
      W1(I)=VR*COSTH+VTD*SINTH
      IF (ABS(U1(I)).LT.1.E-06) U1(I)=0.0
      IF (ABS(V1(I)).LT.1.E-06) V1(I)=0.0
      IF (ABS(W1(I)).LT.1.E-06) W1(I)=0.0
      100 CONTINUE
      RETURN
      END

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      SUBROUTINE VELNOR(XX,YY,ZZ)
C
C VERSION: DEMUNI
C
C THIS SUBROUTINE CALCULATES PERTURBATION VELOCITIES INDUCED BY
C THE WING AND BODY INTERFERENCE PANELS USING SUPERPOSITION SCHEME
C SUPERPOSITION OF 4 CORNER SOLUTIONS IS USED
C VELNOR RETURNS VELOCITIES UP,VP,WP IN WING REFERENCE FRAME...
C
C LOGICAL ASYM,ASYMI,DELTA,BODY,NOSYM,IGTNP,NOPR
C
C COMMON/ONE/CIRC(250),DELTP(250),FN(250),PNLC(250),SWPPLE(250),
C 13*PPTC(250),DUM1(1000),YCPT(250),ZCPT(250),XLF(250),XLR(250),
C 2XWF(250),XWB(250),YLC(250),YRC(250),ZLF(250),ZWF(250),ZLR(250),
C 3ZRR(250),ANT(125),CST(125),DUM2(550),
C 3 XFRIP(100),A,ALFA,ALFR,AWING,H2,B2V,HETA,
C 4HETAR,CONST,COSALF,COSHET,CN,DX,EN,FHACH,HA,SINALF,SINHET,SLOPE,
C 5SLRNC,TIPY,TOTLR,U,V,W,UP,VP,WP,WIP,X,Y,Z,ZT,IF,II,MJ,MSH,MSL,
C 6MSWU,MSWD,MSIP,MSRX,MSY,MSZ,MAG,MWP,NPR,NRP,NIP,NOCPT,NOLNP,NOUT,
C 7NPANLS,NPRESS,NWPP,ASYMI,BODY,DELTA,NOSYM
C

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0428	1
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COMMON/WHTR/THTI(125),X=LE	0428	22
COMMON /INTRDT/ PHIDIH,THTI1,YH00,ZB00,PHIFR,PHIFU	0428	23
C DATA PI/3,141592653590/	0428	24
C	0428	25
1 FORMAT(5X,5HPANEL,14,6X,6HCORNER,12,	0428	26
1 6X,4HC,P,,15,3X,4HY = ,E12.5,3X,4HY = ,E12.5,	0428	27
1 3X,4HZ = E12.5/6X,4HU = ,E12.5,6X,4HV = ,E12.5,6X,4HW = ,E12.5/	0428	28
2 5X,5HTU = ,E12.5,5X,5HTV = ,E12.5,5X,5HTW = ,E12.5)	0428	29
2 FORMAT(1X,7HASYM = ,L3)	0428	30
C	0428	31
ASYM= N0SYM	0428	32
N0PR= (NPR,NE,0)	0428	33
DTOR=PI/180,0	0428	34
C	0428	35
UP=0.	0428	36
VP=0.	0428	37
WP=0.	0428	38
XI=XX	0428	39
YI=YY	0428	40
ZI=ZZ	0428	41
C	0428	42
I IS INDEX OF INFLUENCING PANEL	0428	43
C	0428	44
DO 100 I=II,IF	0428	45
IGTNP= I,GT,NPANLS	0428	46
K=I-NPANLS	0428	47
MI=I	0428	48
TU=0.	0428	49
TV=0.	0428	50
TW=0.	0428	51
EM1=SWPPLE(I)	0428	52
EM2=SWPPTE(I)	0428	53
C	0428	54
C***** CORNER 1 *****	0428	55
C	0428	56
C	0428	57
C	0428	58
C	0428	59
C IF INFLUENCER IS A BODY INTERFERENCE PANEL,SUPERPOSITION IS	0428	60
C PERFORMED IN THE WING SYSTEM , SAME FOR INTERDIGITATED FINS.	0428	61
C NOTE: BODY INTERFERENCE PANELS IN 2ND. AND 4TH. QUARTERS ACT LIKE	0428	62
C WING PANELS WITH NEGATIVE SWEEP	0428	63
C	0428	64
IF (I,LE,NPANLS) GO TO 60	0428	65
IF ((THTI(K),GT,90,0,AND,THTI(K),LE,180,0),OR,	0428	66
1(THTI(K),GT,270,0,AND,THTI(K),LE,360,0)) GO TO 15	0428	67
60 CONTINUE	0428	68
IF (I,LE,NHP) PHIF=PHIFR*DTOR	0428	69
IF (I,GT,NHP,AND,I,LE,NPANLS) PHIF=PHIFR*DTOR	0428	70
IF (EM1,LT,0,0) GO TO 15	0428	71
SLOPE=PMI	0428	72
PM=EM1	0428	73
X=XI-XLF(I)	0428	74
Y=YI-YLC(I)	0428	75
Z=ZI-ZLF(I)	0428	76
IF (ARS(X),LE,TLRNC) X=0,0	0428	77
IF (ARS(Y),LE,TLRNC) Y=0,0	0428	78
IF (ARS(Z),LE,TLRNC) Z=0,0	0428	79
V=XYT	0428	80
Z=ZT	0428	81
IF (,NOT,IGTNP) CALL ROT=F(YT,ZT,Y,Z,PHIF)	0428	82
C	0428	83
C FOR PANELS WITH POSITIVE SWEEP,SUPERPOSITION IS CORNER 1=2+3+4.	0428	84

C			DM28	85
C	IF INFLUENCER IS A BODY INFLUENCING PANEL, TRANSFORM WING Y,Z		DM28	86
C	COORDINATES INTO BIP COORDINATE SYSTEM, ONLY NEED TO ROTATE SINCE		DM28	87
C	ORIGIN IS ALREADY AT BIP CORNER		DM28	88
C	THEN TRANSFORM VELOCITIES FROM BIP FRAME BACK TO WING, SAME FOR		DM28	89
C	INTERDIGITATED FINS.		DM28	90
C			DM28	91
	IF (IGTNP) CALL ROTNH(Y,Z,W,Y,Z,K)		DM28	92
	CALL VELO		DM28	93
	VB=V		DM28	94
	WB=W		DM28	95
	VT=V		DM28	96
	WT=W		DM28	97
	IF (.NOT.IGTNP) CALL ROTF=(VT,WT,V,W,PHIF)		DM28	98
	IF (IGTNP) CALL ROTNH(VB,WB,V,W,K)		DM28	99
	TU=TU+U		DM28	100
	TV=TV+V		DM28	101
	TW=TW+W		DM28	102
	ICNR=I		DM28	103
	MNJ=MJ		DM28	104
	IF (NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW		DM28	105
	IF (NOPR) WRITE(6,2) ASYM		DM28	106
	IF (ASYM) GO TO 10		DM28	107
	YT=(YI+YLC(I))		DM28	108
	Y=YT		DM28	109
	IF (.NOT.IGTNP) CALL ROTF=(YT,ZT,Y,Z,PHIF)		DM28	110
	IF (IGTNP) CALL ROTNH(Y,Z,W,Y,Z,K)		DM28	111
	CALL VELO		DM28	112
	VB=V		DM28	113
	WB=W		DM28	114
	VT=V		DM28	115
	WT=W		DM28	116
	IF (.NOT.IGTNP) CALL ROTF=(VT,WT,V,W,PHIF)		DM28	117
	IF (IGTNP) CALL ROTNH(VB,WB,V,W,K)		DM28	118
	TU=TU+U		DM28	119
	TV=TV+V		DM28	120
	TW=TW+W		DM28	121
	MNJ=MJ		DM28	122
	IF (NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW		DM28	123
	GO TO 10		DM28	124
C			DM28	125
C			DM28	126
C	FOR PANELS WITH NEGATIVE SWEEP, SUPERPOSITION IS CORNER -1+2+3=4		DM28	127
C			DM28	128
C	CORNER 1 FOR M.LT,0.0		DM28	129
C			DM28	130
15	CONTINUE		DM28	131
	SLOPE=EM1		DM28	132
	FM=FM1		DM28	133
	X=XI-XLF(I)		DM28	134
	Y=YI-YLC(I)		DM28	135
	Z=ZI-ZLF(I)		DM28	136
	IF (ABS(X),LE,TLRNC) X=0.0		DM28	137
	IF (ABS(Y),LE,TLRNC) Y=0.0		DM28	138
	IF (ABS(Z),LE,TLRNC) Z=0.0		DM28	139
	Y=YT		DM28	140
	Z=ZT		DM28	141
	IF (.NOT.IGTNP) CALL ROTF=(YT,ZT,Y,Z,PHIF)		DM28	142
	IF (IGTNP) CALL ROTNH(Y,Z,W,Y,Z,K)		DM28	143
	Y=V		DM28	144
	CALL VELO		DM28	145
	VT=V		DM28	146
	WT=W		DM28	147

VW=V	DM28 148
WB=W	DM28 149
IF (.NOT.IGTNP) CALL ROTF=(VT,WT,V,W,PHIF)	DM28 150
IF (IGTNP) CALL ROTH=(VW,WB,V,W,K)	DM28 151
TU=U	DM28 152
TV=V	DM28 153
TW=W	DM28 154
ICNR=1	DM28 155
MNJ=MJ	DM28 156
IF (NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM28 157
IF (ASYM) GO TO 17	DM28 158
YT=(YI+VLC(I))	DM28 159
Y=YT	DM28 160
IF (.NOT.IGTNP) CALL ROTF=(YT,ZT,Y,Z,PHIF)	DM28 161
IF (IGTNP) CALL ROTH=(YW,ZW,Y,Z,K)	DM28 162
Y=Z	DM28 163
CALL VELO	DM28 164
VT=V	DM28 165
WT=W	DM28 166
VW=V	DM28 167
WB=W	DM28 168
IF (.NOT.IGTNP) CALL ROTF=(VT,WT,V,W,PHIF)	DM28 169
IF (IGTNP) CALL ROTH=(VW,WB,V,W,K)	DM28 170
TU=U	DM28 171
TV=TV+V	DM28 172
TW=TW+W	DM28 173
MNJ=MJ	DM28 174
IF (NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM28 175
GO TO 17	DM28 176
10 CONTINUE	DM28 177
C ***** CORNER 2 *****	DM28 178
C	DM28 179
X=XI=XRF(I)	DM28 180
YT=YI=YRC(I)	DM28 181
ZI=ZI=ZRF(I)	DM28 182
IF (ABS(X),LE,TLRNC) Y=0.0	DM28 183
IF (ABS(YT),LE,TLRNC) YT=0.0	DM28 184
IF (ABS(ZI),LE,TLRNC) ZI=0.0	DM28 185
Y=YT	DM28 186
Z=ZI	DM28 187
IF (.NOT.IGTNP) CALL ROTF=(YT,ZT,Y,Z,PHIF)	DM28 188
IF (IGTNP) CALL ROTH=(YW,ZW,Y,Z,K)	DM28 189
CALL VELO	DM28 190
V=V	DM28 191
W=W	DM28 192
VT=V	DM28 193
WT=W	DM28 194
IF (.NOT.IGTNP) CALL ROTF=(VT,WT,V,W,PHIF)	DM28 195
IF (IGTNP) CALL ROTH=(VW,WB,V,W,K)	DM28 196
TU=U	DM28 197
TV=TV+V	DM28 198
TW=TW+W	DM28 199
ICNR=2	DM28 200
MNJ=MJ	DM28 201
IF (NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM28 202
IF (ASYM) GO TO 20	DM28 203
YT=(YI+YRC(I))	DM28 204
Y=YT	DM28 205
IF (.NOT.IGTNP) CALL ROTF=(YT,ZT,Y,Z,PHIF)	DM28 206
IF (IGTNP) CALL ROTH=(YW,ZW,Y,Z,K)	DM28 207
CALL VELO	DM28 208
V=V	DM28 209
	DM28 210

WHBW	0428 211
VTBV	0428 212
WTBW	0428 213
IF (.NOT.IGTNP) CALL ROTF*(VT,WT,V,*,PHIF)	0428 214
IF (IGTNP) CALL ROTHW*(VB,*,B,V,W,K)	0428 215
TUSTU=U	0428 216
TV=TV+V	0428 217
TW=TW+W	0428 218
MNJ=MJ	0428 219
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,*,TU,TV,TW	0428 220
GO TO 20	0428 221
C	0428 222
C CORNER 2 FOR M .LT. 0	0428 223
C	0428 224
17 CONTINUE	0428 225
X=XI-XRF(I)	0428 226
Y=YI-YRC(I)	0428 227
Z=ZI-ZRF(I)	0428 228
IF (ABS(X).LE.TLRNC) X=0.0	0428 229
IF (ABS(Y).LE.TLRNC) Y=0.0	0428 230
IF (ABS(Z).LE.TLRNC) Z=0.0	0428 231
Y=BYT	0428 232
Z=ZI	0428 233
IF (.NOT.IGTNP) CALL ROTF*(YT,ZT,Y,Z,PHIF)	0428 234
IF (IGTNP) CALL ROTHW*(YW,ZW,Y,Z,K)	0428 235
Y=Y	0428 236
CALL VELO	0428 237
VT=V	0428 238
WT=W	0428 239
VB=V	0428 240
WB=W	0428 241
IF (.NOT.IGTNP) CALL ROTF*(VT,WT,V,W,PHIF)	0428 242
IF (IGTNP) CALL ROTHW*(VB,WB,V,W,K)	0428 243
TUSTU=U	0428 244
TV=TV+V	0428 245
TW=TW+W	0428 246
ICNR=2	0428 247
MNJ=MJ	0428 248
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	0428 249
IF(ASYM) GO TO 20	0428 250
YI=(YI+YRC(I))	0428 251
Y=BYT	0428 252
IF (.NOT.IGTNP) CALL ROTF*(YT,ZT,Y,Z,PHIF)	0428 253
IF (IGTNP) CALL ROTHW*(YW,ZW,Y,Z,K)	0428 254
Y=Y	0428 255
CALL VELO	0428 256
VT=V	0428 257
WT=W	0428 258
VB=V	0428 259
WB=W	0428 260
IF (.NOT.IGTNP) CALL ROTF*(VT,WT,V,W,PHIF)	0428 261
IF (IGTNP) CALL ROTHW*(VB,WB,V,W,K)	0428 262
TUSTU=U	0428 263
TV=TV+V	0428 264
TW=TW+W	0428 265
MNJ=MJ	0428 266
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	0428 267
20 CONTINUE	0428 268
C	0428 269
C***** CORNER 3 *****	0428 270
C	0428 271
IF (I.LE.NPANLS) GO TO 61	0428 272
IF ((TMTI(K).GT.90.0.AND.TMTI(K).LE.180.0).OR.	0428 273

1(TMTI(K),GT,270,0,AND,TMTI(K),LE,360,0)) GO TO 19	0428 274
61 IF (EM2,LT,0.0) GO TO 19	0428 275
EM=EM2	0428 276
SL(IPF=EM2	0428 277
X=XI-XLH(I)	0428 278
YT=YI-YLC(I)	0428 279
ZT=ZI-ZLB(I)	0428 280
Y=YT	0428 281
IF (ABS(X),LE,TLRNC) X=0,0	0428 282
IF (ABS(YT),LE,TLRNC) YT=0,0	0428 283
IF (ABS(ZT),LE,TLRNC) ZT=0,0	0428 284
Z=ZT	0428 285
IF (.NOT,IGTNP) CALL ROTWF(YT,ZT,Y,Z,PHIF)	0428 286
IF (IGTNP) CALL ROTWB(Y,Z,W,Y,Z,K)	0428 287
CALL VELO	0428 288
VB=V	0428 289
WB=W	0428 290
VT=V	0428 291
WT=W	0428 292
IF (.NOT,IGTNP) CALL ROTWF(VT,WT,V,W,PHIF)	0428 293
IF (IGTNP) CALL ROTWB(VB,WB,V,W,K)	0428 294
TU=U	0428 295
TV=V	0428 296
TW=W	0428 297
ICNR=3	0428 298
MNJ=MJ	0428 299
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	0428 300
IF(ASYM) GO TO 30	0428 301
YT=(YI+YLC(I))	0428 302
Y=YT	0428 303
IF (.NOT,IGTNP) CALL ROTWF(YT,ZT,Y,Z,PHIF)	0428 304
IF (IGTNP) CALL ROTWB(Y,Z,W,Y,Z,K)	0428 305
CALL VELO	0428 306
VB=V	0428 307
WB=W	0428 308
VT=V	0428 309
WT=W	0428 310
IF (.NOT,IGTNP) CALL ROTWF(VT,WT,V,W,PHIF)	0428 311
IF (IGTNP) CALL ROTWB(VB,WB,V,W,K)	0428 312
TU=U	0428 313
TV=V	0428 314
TW=W	0428 315
MNJ=MJ	0428 316
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	0428 317
GO TO 30	0428 318
C	0428 319
C	0428 320
C	0428 321
19 CONTINUE	0428 322
SLOPE=EM2	0428 323
EM=EM2	0428 324
X=XI-XLH(I)	0428 325
YT=YI-YLC(I)	0428 326
ZT=ZI-ZLB(I)	0428 327
IF (ABS(X),LE,TLRNC) X=0,0	0428 328
IF (ABS(YT),LE,TLRNC) YT=0,0	0428 329
IF (ABS(ZT),LE,TLRNC) ZT=0,0	0428 330
Y=YT	0428 331
Z=ZT	0428 332
IF (.NOT,IGTNP) CALL ROTWF(YT,ZT,Y,Z,PHIF)	0428 333
IF (IGTNP) CALL ROTWB(Y,Z,W,Y,Z,K)	0428 334
Y=V	0428 335
CALL VELO	0428 336



VT=V	DM2A 337
WT=W	DM2A 338
VH=V	DM2A 339
WH=W	DM2A 340
IF (.NOT.IGTNP) CALL ROTFW(VT,WT,V,W,PHIF)	DM2A 341
IF (IGTNP) CALL ROTBW(VB,WB,V,W,K)	DM2B 342
TU=TU+U	DM2B 343
TV=TV+V	DM2B 344
TW=TW+W	DM2A 345
ICNR=3	DM2A 346
MNJ=MJ	DM2A 347
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM2B 348
IF(ASYM) GO TO 21	DM2A 349
YT=(YI+YLC(I))	DM2B 350
Y=YT	DM2A 351
IF (.NOT.IGTNP) CALL ROTWF(YT,ZT,Y,Z,PHIF)	DM2B 352
IF (IGTNP) CALL ROTWB(YW,ZW,Y,Z,K)	DM2B 353
Y=Y	DM2B 354
CALL VELO	DM2A 355
VH=V	DM2B 356
WH=W	DM2A 357
VT=V	DM2B 358
WT=W	DM2B 359
IF (.NOT.IGTNP) CALL ROTFW(VT,WT,V,W,PHIF)	DM2B 360
IF (IGTNP) CALL ROTBW(VB,WB,V,W,K)	DM2B 361
TU=TU+U	DM2B 362
TV=TV+V	DM2B 363
TW=TW+W	DM2B 364
MNJ=MJ	DM2B 365
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM2B 366
GO TO 21	DM2B 367
30 CONTINUE	DM2B 368
C ***** CORNER 4 *****	DM2B 369
C	DM2B 370
X=XI-XRB(I)	DM2B 371
YT=YI-YRC(I)	DM2B 372
ZT=ZI-ZRB(I)	DM2B 373
IF (ABS(X),LE,TLRNC) X=0.0	DM2B 374
IF (ABS(YT),LE,TLRNC) YT=0.0	DM2B 375
IF (ABS(ZT),LE,TLRNC) ZT=0.0	DM2B 376
Y=YT	DM2B 377
Z=ZT	DM2B 378
IF (.NOT.IGTNP) CALL ROTWF(YT,ZT,Y,Z,PHIF)	DM2B 379
IF (IGTNP) CALL ROTWB(YW,ZW,Y,Z,K)	DM2B 380
CALL VELO	DM2B 381
VH=V	DM2B 382
WH=W	DM2B 383
VT=V	DM2B 384
WT=W	DM2B 385
IF (.NOT.IGTNP) CALL ROTFW(VT,WT,V,W,PHIF)	DM2B 386
IF (IGTNP) CALL ROTBW(VB,WB,V,W,K)	DM2B 387
TU=TU+U	DM2B 388
TV=TV+V	DM2B 389
TW=TW+W	DM2B 390
ICNR=4	DM2B 391
MNJ=MJ	DM2B 392
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW	DM2B 393
IF(ASYM) GO TO 40	DM2B 394
YT=(YI+YRC(I))	DM2B 395
Y=YT	DM2B 396
IF (.NOT.IGTNP) CALL ROTWF(YT,ZT,Y,Z,PHIF)	DM2B 397
IF (IGTNP) CALL ROTWB(YW,ZW,Y,Z,K)	DM2B 398
CALL VELO	DM2B 399
	DM2B 400

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VT=V
*TW
IF (.NOT.IGTNP) CALL ROTFW(VT,WT,V,W,PHIF)
IF (IGTNP) CALL ROTHW(VH,WB,V,W,K)
TU=U+U
TV=TV+V
T=TW+W
MNJ=MJ
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW
GO TO 40

C
C CORNER 4 FOR M.LT,0
C
21 CONTINUE
X=XI-XRR(I)
YI=YI-YRC(I)
ZT=ZT-ZRH(I)
IF (ABS(X).LE.TLRNC) X=0.0
IF (ABS(YI).LE.TLRNC) YI=0.0
IF (ABS(ZT).LE.TLRNC) ZT=0.0
Y=YT
Z=ZT
IF (.NOT.IGTNP) CALL ROTWF(YT,ZT,Y,Z,PHIF)
IF (IGTNP) CALL ROTWR(YW,ZW,Y,Z,K)
Y=Y
CALL VELO
VT=V
*TW
VH=V
WB=W
IF (.NOT.IGTNP) CALL ROTFW(VT,WT,V,W,PHIF)
IF (IGTNP) CALL ROTHW(VH,WB,V,W,K)
TU=U+U
TV=TV+V
T=TW+W
ICNR=4
MNJ=MJ
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW
IF(ASYM) GO TO 40
YI=YI+YRC(I)
Y=YT
IF (.NOT.IGTNP) CALL ROTWF(YT,ZT,Y,Z,PHIF)
IF (IGTNP) CALL ROTWR(YW,ZW,Y,Z,K)
Y=Y
CALL VELO
VH=V
WB=W
VT=V
*TW
IF (.NOT.IGTNP) CALL ROTFW(VT,WT,V,W,PHIF)
IF (IGTNP) CALL ROTHW(VH,WB,V,W,K)
TU=U+U
TV=TV+V
T=TW+W
MNJ=MJ
IF(NOPR) WRITE(6,1) MI,ICNR,MNJ,X,Y,Z,U,V,W,TU,TV,TW
40 CONTINUE
C
IF(II.EQ.IF.AND.NOCPT.EQ.0) GO TO 101
UP=UP+TU*DELTP(I)
VP=VP+TV*DELTP(I)
WP=WP+TW*DELTP(I)
100 CONTINUE

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	UP=UP/CONST	0428 464
	VP=VP/CONST	0428 465
	WP=WP/CONST	0428 466
	RETURN	0428 467
C		0428 468
C	UP,VP,WP BELOW ARE FOR SETTING UP INFLUENCE FUNCTIONS FOR USE IN	0428 469
C	THE INFLUENCE MATRIX	0428 470
C		0428 471
101	UP=U	0428 472
	VP=V	0428 473
	WP=W	0428 474
	RETURN	0428 475
	END	0428 476

	SUBROUTINE VELO	0429 1
C		0429 2
C	VERSION:DEMON2.	0429 3
C		0429 4
C	THIS SUBROUTINE CALCULATES THE INFLUENCE OF THE BASIC	0429 5
C	SEMI-INFINITE TRIANGLES WHICH ARE UNDER CONSTANT LOADING.	0429 6
C	MORE CORRECTLY, THEY ARE UNDER CONSTANT U DIFFERENCE	0429 7
C	THE COORDINATE SYSTEM USED HERE IS THE COORDINATE SYSTEM ASSUM-	0429 8
C	ED WITH THE TRIANGLE UNDER CONSIDERATION.	0429 9
C		0429 10
	LOGICAL ASYM,BODY,DELTA,NOSYM	0429 11
C		0429 12
	COMMON/DONE/DUM1(6400),A,DUM2(5),BETA,DUM3(6),EM,DUM4(4),SLOPE,	0429 13
	ITLINC,TIPY,TOTLW,U,V,W,DUM5(4),X,Y,Z,S,M1,DUM6(2),M2,DUM7(8),NHP,	0429 14
	2NPR,DUM8(2),NOOPT,NOLINP,NOOUT,NPANELS,DUM9(2),ASYM,BODY,DELTA,NOSYM	0429 15
C		0429 16
	NAMELIST /DEBUG/X,Y,Z,F1,F2, F4,F5, F7,ARG, EML,BETA,U,V,W	0429 17
	1,TOP,BOT,ARGY, ITLINC,YEDGE	0429 18
C		0429 19
	DATA PI/3.141592653590/	0429 20
C		0429 21
C		0429 22
C	STATEMENT FUNCTIONS.	0429 23
C	PLANAR FORMULATION	0429 24
C		0429 25
	FF1(X,Y,Z) = Z*SQRT(XSQ-HTSQ*(YSQ+ZSQ))	0429 26
	FF2(X,Y,Z) = Y*(EML*Y-X)+EML*ZSQ	0429 27
	FF3(X,Y,Z) = EML*ALOG((X+EML-HTSQ*Y	0429 28
	1 + SQRT((X+EML-HTSQ*Y)*(X+EML-HTSQ*Y)	0429 29
	2 + HTSQ*((Y+EML-X)*(Y+EML-X) + EMLSQ*ZSQ-HTSQ*ZSQ))	0429 30
	4 / (BETA*SQRT((Y+EML-X)*(Y+EML-X) + EMLSQ*ZSQ-HTSQ*ZSQ))	0429 31
	6 / SQRT(ABS(EMLSQ-HTSQ))	0429 32
	FF4(X,Y,Z) = (Y/(YSQ+ZSQ))*SQRT(XSQ-HTSQ*(YSQ+ZSQ))	0429 33
	FF5(X,Y,Z) = ALOG((X+SQRT(XSQ-HTSQ*(YSQ+ZSQ))	0429 34
	1 / (BETA*SQRT(YSQ+ZSQ))	0429 35
	FF7(X,Y,Z) = (Z/(YSQ+ZSQ))*SQRT(XSQ-HTSQ*(YSQ+ZSQ))	0429 36
	FF8(X,Y,Z) = (SQRT(XSQ-HTSQ*(YSQ+ZSQ)))/(X-BETA*Y)	0429 37
	FF9(X,Y,Z) = EML*ATAN2(SQRT((HTSQ-EMLSQ)*(XSQ-HTSQ*(YSQ+ZSQ))),	0429 38
	1 X+EML-HTSQ*Y) / SQRT(ABS(EMLSQ-HTSQ))	0429 39
C		0429 40
C		0429 41
	Y=YS	0429 42
	Z=ZS	0429 43
	TOP=0.0	0429 44
	BOT=0.0	0429 45
		0429 46

EML=EM	DM29 47
XSQ=X*Y	DM29 48
YSQ=Y*Y	DM29 49
ZSQ=Z*Z	DM29 50
HTSQ=BETA*PIA	DM29 51
EMLSQ=EML*EML	DM29 52
C	DM29 53
C CHECK FOR SUBSONIC, SONIC OR SUPERSONIC LEADING EDGE	DM29 54
C	DM29 55
IF (X.LT.0.0) GO TO 50	DM29 56
IF (X.EQ.0.0.AND.Y.EQ.0.0.AND.Z.EQ.0.0) GO TO 50	DM29 57
IF (ABS(EML).LT.(100.0+TLRNC)) GO TO 120	DM29 58
YEDGE=X/EML	DM29 59
GO TO 121	DM29 60
120 YEDGE=10.0E+07	DM29 61
GO TO 20	DM29 62
C	DM29 63
C CHECK FOR SUBSONIC, SONIC, OR SUPERSONIC LEADING EDGE	DM29 64
C	DM29 65
121 ARG=HTSQ*(1./EMLSQ)	DM29 66
IF (ABS(ARG-1.0).LT.TLRNC) GO TO 25	DM29 67
IF (ARG.LT.1.0) GO TO 10	DM29 68
RHT=SQRT(YSQ+ZSQ)*BETA	DM29 69
IF (X.GT.RHT) GO TO 63	DM29 70
GO TO 21	DM29 71
50 U=0.	DM29 72
V=0.	DM29 73
W=0.	DM29 74
RETURN	DM29 75
C	DM29 76
C SUPERSONIC LEADING EDGE CASE --	DM29 77
C	DM29 78
20 CONTINUE	DM29 79
C	DM29 80
C CHECK IF POINT (X,Y,Z) LIES INSIDE, ON, OR OUTSIDE MACH CONE	DM29 81
C FROM ORIGIN	DM29 82
C	DM29 83
RHT=SQRT(YSQ+ZSQ)*BETA	DM29 84
IF (X.GT.RHT) GO TO 24	DM29 85
21 IF (Y.LT.0.0.OR.Y.GE.YEDGE) GO TO 50	DM29 86
C	DM29 87
C POINT LIES OUTSIDE MACH CONE FROM ORIGIN BUT THE POINT LIES	DM29 88
C INSIDE MACH CONE FROM LEADING EDGE AT SAME Y AS P(X,Y,Z)	DM29 89
C	DM29 90
YC=X*EML/RHTSQ	DM29 91
IF (Y.LT.YC) GO TO 50	DM29 92
XLE=Y/RLOPE	DM29 93
XTRNSF=X-XLE	DM29 94
IF (ABS(XTRNSF).LE.(100.0+TLRNC)) XTRNSF=0.0	DM29 95
ZCONE=XTRNSF/(SQRT(HTSQ-EMLSQ))	DM29 96
IF (ABS(Z).GT.ZCONE) GO TO 50	DM29 97
IF (ABS(Z).LT.TLRNC.OR.(Z).GT.0.) GO TO 70	DM29 98
GO TO 71	DM29 99
70 F1=PI	DM29 100
GO TO 74	DM29 101
71 F1=PI	DM29 102
74 F2=(EML*PI)/SQRT(ABS(HTSQ-EMLSQ))	DM29 103
IF (ABS(EML).LT.(100.0+TLRNC)) F2=BETA*PI	DM29 104
IF (XTRNSF.EQ.0.0.AND.Z.EQ.0.0) F2=F2/2.0	DM29 105
F4=0.0	DM29 106
F5=0.	DM29 107
F7=0.0	DM29 108
GO TO 47	DM29 109
C	

C	POINT LIES INSIDE MACH CONE FROM ORIGIN	0429 110
C		0429 111
	24 CONTINUE	0429 112
	F2=BETA*ATAN2(SQRT(X*X-BTSQ*(YSQ+ZSQ)), -BETA*Y)	0429 113
	GO TO 22	0429 114
	63 F2=FF3(X,Y,Z)	0429 115
	GO TO 22	0429 116
C		0429 117
C	SONIC LEADING EDGE CASE==	0429 118
C		0429 119
	25 CONTINUE	0429 120
C		0429 121
C	CHECK IF POINT(X,Y,Z) LIES ON OR OUTSIDE MACH CONE FROM ORIGIN	0429 122
C	IF TRUE SET PERTURBATION VELOCITIES EQUAL TO ZERO	0429 123
C		0429 124
	RHT=SQRT(YSQ+ZSQ)*BETA	0429 125
	IF (X,LE,RHT) GO TO 50	0429 126
	F2=FF3(X,Y,Z)	0429 127
	XTRNSF=X-XLE	0429 128
	IF (XTRNSF,EQ,0.0,AND,Z,EQ,0.0) F2=F2/2.0	0429 129
	GO TO 22	0429 130
C		0429 131
C	SUBSONIC LEADING EDGE CASE==	0429 132
C		0429 133
	10 CONTINUE	0429 134
C		0429 135
C	CHECK IF POINT (X,Y,Z) LIES ON OR OUTSIDE MACH CONE	0429 136
C	IF TRUE SET PERTURBATION VELOCITIES TO ZERO	0429 137
C		0429 138
	RHT=SQRT(YSQ+ZSQ)*BETA	0429 139
	IF(X,LE,RHT) GO TO 50	0429 140
	ARG2=BETA*SQRT((Y+EML-X)*(Y+EML-X)+EMLSQ+ZSQ-BTSQ+ZSQ)	0429 141
	IF (ABS(ARG2),LT,TLRNC) GO TO 26	0429 142
	F2=FF2(X,Y,Z)	0429 143
	GO TO 22	0429 144
	26 F2=0.0	0429 145
	22 CONTINUE	0429 146
	IF (Y,EQ,0.0,AND,Z,EQ,0.0) GO TO 50	0429 147
	ARGY=Y-YEDGE	0429 148
	IF(ABS(ARGY),LT,(100.0+TLRNC),AND,ABS(Z),LT,TLRNC) GO TO 50	0429 149
	TNP=FF1(X,Y,Z)	0429 150
	HOT=FF18(X,Y,Z)	0429 151
	IF(ABS(TNP),GE,TLRNC) GO TO 43	0429 152
	IF (Y,GT,0.0,AND,Y,LT,YEDGE,AND,ABS(Z) .LT,TLRNC) GO TO 48	0429 153
	GO TO 44	0429 154
	48 F1=PI	0429 155
	GO TO 46	0429 156
	43 F1=ATAN2(TNP,HOT)	0429 157
	IF(ABS(F1),LT,TLRNC) F1=0.	0429 158
	GO TO 46	0429 159
	44 F1=0.0	0429 160
	46 CONTINUE	0429 161
	F4=FF4(X,Y,Z)	0429 162
	F5=FF5(X,Y,Z)	0429 163
	F7=FF7(X,Y,Z)	0429 164
C		0429 165
C	CALCULATE PERTURBATION VELOCITIES U/V,V/V,W/V	0429 166
C		0429 167
	47 U=F1	0429 168
	IF(ABS(EML),LT,(100.0+TLRNC)) GO TO 101	0429 169
	V=EML*F1+F7	0429 170
	W= (EML*(ABS (1.0-BTSQ/EMLSQ)*F2-F5)-F4)	0429 171
	GO TO 102	0429 172

101	CONTINUE	DM29	173
	V = F7	DM29	174
	W = F4 + F2	DM29	175
102	CONTINUE	DM29	176
C		DM29	177
	IF (NPR, ME, 0) WRITE (6, DEBUG)	DM29	178
C		DM29	179
	RETURN	DM29	180
	END	DM29	181
	SUBROUTINE VELOTH	DM30	1
C		DM30	2
C	VERSION: DEMON1	DM30	3
C		DM30	4
C	THIS SUBROUTINE CALCULATES THE INFLUENCE OF A SEMI-INFINITE	DM30	5
C	TRIANGLE WITH CONSTANT SOURCE STRENGTH.	DM30	6
C		DM30	7
	LOGICAL VERPNL, INSIDE, NPR	DM30	8
C		DM30	9
	COMMON/THVARG/XTH,YTH,ZTH,UTH,VTH,WTH,EML,VERPNL,NPR	DM30	10
C	COMMON/THVFLO/BETA,TLRNC,BTSQ	DM30	11
C		DM30	12
	NAMLIST/DEBUG/X,Y,Z,EML,INSIDE,ARG1,BETA,F1,F2,F5,	DM30	13
C	UTH,VTH,WTH,YEDGE,ARGY	DM30	14
C	DATA PI/3,14159265/	DM30	15
C		DM30	16
C	SET VELOCITIES TO ZERO FOR WHATEVER REASON	DM30	17
C		DM30	18
	IF(XTH.GE.TLRNC) GO TO 3	DM30	19
C	1 UTH=0.0	DM30	20
	VTH=0.0	DM30	21
	WTH=0.0	DM30	22
	RETURN	DM30	23
C		DM30	24
C	CHECK IF THE INFLUENCING PANEL IS A VERTICAL PANEL.	DM30	25
C	IF SQ, Y=ZTH AND Z=YTH	DM30	26
C	THI TRANSFORMATION ROTATES SEMI INFINITE TRIANGLE 90 DEG. IN	DM30	27
C	COUNTERCLOCKWISE DIRECTION.	DM30	28
C		DM30	29
	3 CONTINUE	DM30	30
	X=XTH	DM30	31
	IF(VERPNL) GO TO 4	DM30	32
	Y=YTH	DM30	33
	Z=ZTH	DM30	34
	GO TO 5	DM30	35
C	4 Y=ZTH	DM30	36
	Z=YTH	DM30	37
C	5 YSQ=Y*Y	DM30	38
	ZSQ=Z*Z	DM30	39
	EMLSQ=EML*EML	DM30	40
	ARG1=X*X-BTSQ*(YSQ+ZSQ)	DM30	41
	INSIDE=ARG1.GT.TLRNC	DM30	42
C		DM30	43
C	CHECK FOR SPECIAL CASE OF UNSWEPT LEADING EDGE	DM30	44
C		DM30	45
	IF(ABS(EML).LT.(100.0+TLRNC)) GO TO 70	DM30	46
	YEDGE=X/EML	DM30	47
	ARGY=Y-YEDGE	DM30	48
C		DM30	49
C	CHECK WHETHER LEADING EDGE IS SUBSONIC, SONIC, OR SUPERSONIC	DM30	50

C	STEST=BTSQ=EMLSQ	0430	51
	IF(ABS(STEST).LT.TLRNC) GO TO 20	0430	52
	IF(STEST.GT.0.0) GO TO 30	0430	53
C	***** SUBSONIC LEADING EDGE *****	0430	54
C		0430	55
C	DETERMINE IF POINT LIES INSIDE OR OUTSIDE MACH CONE FROM ORIGIN	0430	56
C	IF IT LIES OUTSIDE, SET PERTURBATION VELOCITIES TO ZERO	0430	57
C		0430	58
C	IF(.NOT.INSIDE) GO TO 1	0430	59
C	POINT LIES INSIDE MACH CONE FROM ORIGIN	0430	60
C		0430	61
C	RAD=SQRT(ARG1)	0430	62
C	T1=X*EML-BTSQ*Y	0430	63
C	T2=BETA*SQRT((Y*EML-X)*(Y*EML-X)+ZSQ*(EMLSQ-BTSQ))	0430	64
C		0430	65
C	TEST FOR POSSIBLE SINGULARITY IN F1 OR F2	0430	66
C		0430	67
C	IF(ABS(ARGY).LT.(100.0*TLRNC).AND.ABS(Z).LT.TLRNC) GO TO 1	0430	68
C	F2=(EML/SQRT(EMLSQ-BTSQ))*ALOG((T1+SQRT(T1*T1-T2*T2))/T2)	0430	69
C	IF(ABS(Y).LT.TLRNC.AND.ABS(Z).LT.TLRNC) GO TO 13	0430	70
C	F1=ATAN2(Z*RAD,EML*(YSQ+ZSQ)-Y*X)	0430	71
C	F5=ALOG((X+RAD)/(BETA*SQRT(YSQ+ZSQ)))	0430	72
C	GO TO 100	0430	73
C		0430	74
C	CASE FOR Y AND Z BOTH SMALL	0430	75
C		0430	76
C	13 F1=0.0	0430	77
C	VTH=0.0	0430	78
C	GO TO 101	0430	79
C		0430	80
C	***** SONIC LEADING EDGE *****	0430	81
C		0430	82
C	20 IF(.NOT.INSIDE) GO TO 1	0430	83
C	RAD=SQRT(ARG1)	0430	84
C	F2=RAD/(X-BETA*Y)	0430	85
C		0430	86
C	F1 AND F5 SAME AS IN SUBSONIC LEADING EDGE	0430	87
C		0430	88
C	IF(ABS(Y).LT.TLRNC.AND.ABS(Z).LT.TLRNC) GO TO 21	0430	89
C	F5=ALOG((X+RAD)/(BETA*SQRT(YSQ+ZSQ)))	0430	90
C	IF(ABS(ARGY).LT.TLRNC.AND.ABS(Z).LT.TLRNC) GO TO 22	0430	91
C	F1=ATAN2(Z*RAD,EML*(YSQ+ZSQ)-Y*X)	0430	92
C	GO TO 100	0430	93
C		0430	94
C	Y AND Z BOTH SMALL	0430	95
C		0430	96
C	21 F1=0.	0430	97
C	VTH = 0.	0430	98
C	GO TO 101	0430	99
C		0430	100
C	Z SMALL AND Y CLOSE TO LEADING EDGE	0430	101
C		0430	102
C	22 F1=0.	0430	103
C	GO TO 100	0430	104
C		0430	105
C	***** SUPERSONIC LEADING EDGE *****	0430	106
C		0430	107
C	DETERMINE WHETHER POINT LIES INSIDE MACH CONE FROM ORIGIN	0430	108
C	IF OUTSIDE, THERE IS ONE MORE CHECK TO BE MADE	0430	109
C		0430	110
C		0430	111
C		0430	112
C		0430	113

C	30 IF(INSIDE) GO TO 31	0430 114
C	POINT IS OUTSIDE MACH CONE FROM ORIGIN	0430 115
C	DETERMINE IF IT IS INSIDE MACH CONE FROM LEADING EDGE	0430 116
C	IF OUTSIDE, SET PERTURBATION VELOCITIES TO ZERO	0430 117
C		0430 118
	IF(Y.LT.0.0.OR.Y.GE.YEDGE) GO TO 1	0430 119
	YC=X*EML/RTSQ	0430 120
	IF(Y.LT.YC) GO TO 1	0430 121
	XLE=Y*EML	0430 122
	XTRNSF=X-XLE	0430 123
	ZCONE=XTRNSF/SQRT(STEST)	0430 124
	IF(ABS(Z).GT.ABS(ZCONE)) GO TO 1	0430 125
C		0430 126
C	POINT IS INSIDE MACH CONE FROM LEADING EDGE	0430 127
C		0430 128
	F2=PI*EML/SQRT(RTSQ=EMLSQ)	0430 129
	F1=PI	0430 130
	IF(Z.LT.0.0) F1=-PI	0430 131
	F5=0.0	0430 132
	GO TO 100	0430 133
C		0430 134
C	POINT IS INSIDE MACH CONE FROM ORIGIN	0430 135
C		0430 136
	31 T3=SQRT(RTSQ=EMLSQ)	0430 137
	PAD=SQRT(ARG1)	0430 138
	F2=(EML/T3)*ATAN2(RAD*T3,X*EML-RTSQ*Y)	0430 139
C		0430 140
C	USE F1 AND F5 AS IN SUBSONIC LEADING EDGE CASE	0430 141
C		0430 142
	IF(ABS(Y).LT.TLRNC.AND.ABS(Z).LT.TLRNC) GO TO 32	0430 143
	F5=ALOG((X+RAD)/(BETA*SQRT(YSQ+ZSQ)))	0430 144
	F1=ATAN2(Z*RAD,EML*(YSQ+ZSQ)-Y*X)	0430 145
	GO TO 100	0430 146
C		0430 147
C	Y AND Z BOTH SMALL	0430 148
C		0430 149
	32 F1=0.	0430 150
	VTH=0.	0430 151
	GO TO 101	0430 152
C		0430 153
C		0430 154
C	***** SPECIAL CASE FOR UNSWEPT LEADING EDGE *****	0430 155
C		0430 156
C	DETERMINE WHETHER POINT LIES INSIDE MACH CONE FROM ORIGIN	0430 157
C	IF OUTSIDE, THERE IS ONE MORE CHECK TO BE MADE	0430 158
C		0430 159
	70 IF(INSIDE) GO TO 72	0430 160
C		0430 161
C	POINT IS OUTSIDE MACH CONE FROM ORIGIN	0430 162
C	DETERMINE IF IT IS INSIDE MACH CONE FROM LEADING EDGE	0430 163
C	IF OUTSIDE, SET PERTURBATION VELOCITIES TO ZERO	0430 164
C		0430 165
	IF(Y.LT.0.) GO TO 1	0430 166
	RSTB=ABS(Z)*BETA	0430 167
	XTEST=X-RSTB	0430 168
	IF((RSTB.LT.TLRNC.AND.X.LE.0.).OR.XTEST.LE.TLRNC) GO TO 1	0430 169
C		0430 170
C	POINT BETWEEN MACH CONE FROM ORIGIN AND LEADING EDGE	0430 171
C		0430 172
	UTH=-PI/BETA	0430 173
	F1=PI	0430 174
	IF(Z.LT.0.0) F1=-PI	0430 175
		0430 176



	VTH=0.0	DM30 177
	WTH=F1	DM30 178
	GO TO 102	DM30 179
C		DM30 180
C	POINT IS INSIDE MACH CONE FROM ORIGIN	DM30 181
C		DM30 182
	72 RAD=SQRT(ARG1)	DM30 183
	UTH=-ATAN2(RAD,-BETA*Y)/BETA	DM30 184
	F2=0.0	DM30 185
	IF(ABS(Z) .LT. TLRNC .AND. ABS(Y) .LT. TLRNC)GO TO 73	DM30 186
	F1=ATAN2(Z*RAD,-Y*X)	DM30 187
	F5=ALOG((X+RAD)/(BETA*SQRT(YSQ+ZSQ)))	DM30 188
	VTH=F5	DM30 189
	WTH=F1	DM30 190
	GO TO 102	DM30 191
	73 VTH=0	DM30 192
	WTH=0	DM30 193
	GO TO 102	DM30 194
C		DM30 195
C	COMPUTE PERTURBATION VELOCITIES	DM30 196
C		DM30 197
	100 VTH=F2-F5	DM30 198
	101 UTH=-F2/EML	DM30 199
	WTH=F1	DM30 200
	102 IF(.NOT. VERPNL) GO TO 103	DM30 201
	TEMP=VTH	DM30 202
	VTH=-WTH	DM30 203
	WTH=TEMP	DM30 204
	103 CONTINUE	DM30 205
	IF(NOPR) WRITE(6,DEBUG)	DM30 206
	RETURN	DM30 207
	END	DM30 208

	SUBROUTINE VRTVEL(NSTART,N)	DM31 1
C		DM31 2
C	VERSION: DEMON1	DM31 3
C		DM31 4
C		DM31 5
C	SUBROUTINE FOR CALCULATION OF VELOCITIES INDUCED BY FIXED EXTERNAL	DM31 6
C	VORTICES IN THE PRESENCE OF A CIRCULAR BODY AT FIELDPOINTS	DM31 7
C	WITH COORDINATES XFLOP,YFLOP,ZFLOP.	DM31 8
C		DM31 9
C	THIS SUBROUTINE READS IN UP TO 10 VORTEX STRENGTHS AND THEIR	DM31 10
C	LOCATIONS IN THE CROSSFLOW PLANE	DM31 11
C	Y IS TO THE RIGHT WHEN VIEWING FORWARDS, Z IS UP	DM31 12
C	VORTEX INDUCED VELOCITIES ARE NAMED VVRTX,WVRTX	DM31 13
C		DM31 14
C		DM31 15
C	LOGICAL ASYM,BODY,DELTA,NOSYM	DM31 16
C		DM31 17
C		DM31 18
	COMMON/DNE/CIRC(250),DELTP(250),FN(250),PNLC(250),SWPPLF(250),	DM31 19
	1SWPPTE(250),VNOR(250),XBAR(250),ZBAR(250),XCPT(250),YCPT(250),ZCPTOM	DM31 20
	2(250),XLF(250),XLR(250),XRF(250),XRB(250),YLC(250),YRC(250),ZLF(250)	DM31 21
	30),ZRF(250),ZLR(250),ZRR(250),SNT(125),CST(125),SNT2(125),CST2(125)	DM31 22
	4),IP(300),XFHIP(100),A,ALFA,ALFR,AR=ING,B2,R2V,BETA,BETAR,CONST,	DM31 23
	5COSALF,COSBET,CN,DX,PM,FMACH,RB,SINALF,SINRFT,SLOPE,TLRNC,TIPV,	DM31 24
	6TOTLR,U,V,*,UCHK,VCHK,WCHK,WBIP,X,DUMY,Z,I,IF,II,J,MSWR,MS*L,MSWU,	DM31 25
	7MSWD,MBIP,NCRX,NCN,NDRAG,NRP,NPW,NRP,NJP,NOCPT,NOLINP,NOUT,NPANLS,	DM31 26
	8NPRESS,NWBP,ASYM,BODY,DELTA,NOSYM	DM31 27

COMMON/VVRTX/VVRTX(150),WVRTX(150),NVRTPL,NVRTX,VRTMAX	DM31	24
COMMON/VORSPC/GAMMA(10),YVRTX(10),ZVRTX(10),RLOC	DM31	29
COMMON/BVEL/DUMB(450),XFLOP(150),YFLOP(150),ZFLOP(150)	DM31	30
1 FORMAT (8F10.5)	DM31	31
2 FORMAT (1H1,10X,79H2DIM,VORTEX NON-DIMENSIONAL STRENGTHS AND FIXED	DM31	32
1 COORDINATES IN CROSS LOW PLANE	DM31	33
1 //15X,1H1,10X,6HGAMMA/,23X,2HY/,17X,	DM31	34
22HZ/,24X,23H(2.0*PI*BODY RAD,*VINFI),5X,11H(BODY RAD.),8X,	DM31	35
311H(BODY RAD.)//)	DM31	36
3 FORMAT (15X,12,8X,F10.5,17X,F10.5,9X,F10.5)	DM31	37
READ IN NON-DIMENSIONALIZED VORTEX STRENGTHS,GAMMA=GAMMA/	DM31	38
(2*PI*BODY RADIUS*VINFI)	DM31	39
AND NON-DIMENSIONALIZED LOCATIONS,YVRTX/BODY RADIUS,	DM31	40
ZVRTX/BODY RADIUS	DM31	41
WRITE (6,2)	DM31	42
DO 100 I=1,NVRTX	DM31	43
READ (5,1) GAMMA(I),YVRTX(I),ZVRTX(I)	DM31	44
WRITE (6,3) I,GAMMA(I),YVRTX(I),ZVRTX(I)	DM31	45
100 CONTINUE	DM31	46
COMPUTE VORTEX INDUCED PERTURBATION VELOCITIES AT CONTROL POINTS	DM31	47
OF ALL WING SURFACES AND BODY INTERFERENCE SMOEL.	DM31	48
CONTRIBUTION DUE TO EXTERNAL VORTEX....VVRTXE,WVRTXE	DM31	49
CONTRIBUTION DUE TO IMAGE VORTEX....VVRTXI,WVRTXI	DM31	50
CONTRIBUTION DUE TO CENTER VORTEX....VVRTXC,WVRTXC	DM31	51
NOTE:***CENTER VORTEX EFFECTS ARE SET ZERO	DM31	52
ENTER HERE IF VORTICES HAVE BEEN READ IN ALREADY OR CALCULATED IN	DM31	53
SUBROUTINE HDVPR.	DM31	54
ENTRY VORTEX	DM31	55
DO 101 IC=NSTART,N	DM31	56
Y=VFLOP(IC)/RLOC	DM31	57
YS=Y*Y	DM31	58
Z=ZFLOP(IC)/RLOC	DM31	59
ZS=Z*Z	DM31	60
DENOM=Y*YS+ZS	DM31	61
DO 102 JV=1,NVRTX	DM31	62
ZVSYS=ZVRTX(JV)*ZVRTX(JV)+YVRTX(JV)*YVRTX(JV)	DM31	63
DELTYS=Y*YVRTX(JV)	DM31	64
DELTYS=DELTYS*DELTYS	DM31	65
DELTZ=Z*ZVRTX(JV)	DM31	66
DELTZS=DELTZ*DELTZ	DM31	67
DENOM1=DELTYS+DELTZS	DM31	68
IF ((DENOM1).LE.TLRNC) GO TO 105	DM31	69
VVRTXE=GAMMA(JV)*(DELTZ/DENOM1)	DM31	70
WVRTXE=GAMMA(JV)*(DELTYS/DENOM1)	DM31	71
GO TO 106	DM31	72
105 VVRTXE=0.	DM31	73
WVRTXE=0.	DM31	74
106 CONTINUE	DM31	75
DENOM2=(Y-YVRTX(JV)/ZVSYS)**2+(Z-ZVRTX(JV)/ZVSYS)**2	DM31	76
IF (ABS(DENOM2).LE.TLRNC) GO TO 107	DM31	77
VVRTXI=GAMMA(JV)*(Z-ZVRTX(JV)/ZVSYS)/DENOM2	DM31	78
WVRTXI=GAMMA(JV)*(Y-YVRTX(JV)/ZVSYS)/DENOM2	DM31	79
GO TO 108	DM31	80
107 VVRTXI=0.0	DM31	81
WVRTXI=0.0	DM31	82
108 CONTINUE	DM31	83
	DM31	84
	DM31	85
	DM31	86
	DM31	87
	DM31	88
	DM31	89
	DM31	90

	VVRTXC=0.0	DM31	91
	WVRTXC=0.0	DM31	92
	VVRTX(IC)=VVRTX(IC)+VVRTXE+VVRTXI+VVRTXC	DM31	93
	WVRTX(IC)=WVRTX(IC)+WVRTXE+WVRTXI+WVRTXC	DM31	94
C		DM31	95
C	LIMIT MAGNITUDE OF PERTURBATION VELOCITIES TO VRTMAX.	DM31	96
C		DM31	97
	IF (VVRTX(IC).GT.0.0.AND. ABS(VVRTX(IC)).GE.VRTMAX) VVRTX(IC)=	DM31	98
	1 VRTMAX	DM31	99
	IF (VVRTX(IC).LT.0.0.AND. ABS(VVRTX(IC)).GE.VRTMAX) VVRTX(IC)=	DM31	100
	1 -VRTMAX	DM31	101
	IF (WVRTX(IC).GT.0.0.AND. ABS(WVRTX(IC)).GE.VRTMAX) WVRTX(IC)=	DM31	102
	1 VRTMAX	DM31	103
	IF (-WVRTX(IC).LT.0.0.AND. ABS(WVRTX(IC)).GE.VRTMAX) WVRTX(IC)=	DM31	104
	1 -VRTMAX	DM31	105
	102 CONTINUE	DM31	106
	101 CONTINUE	DM31	107
C		DM31	108
	RETURN	DM31	109
	END	DM31	110
	SUBROUTINE VVELS(NV,VY,ZZ,VX,VY,G,AR,RH,V,W,VRTMAX)	DM32	1
C		DM32	2
C	VERSION: DEMON1	DM32	3
C		DM32	4
C	THIS SUBROUTINE COMPUTES PERTURBATION VELOCITY COMPONENTS DUE TO	DM32	5
C	NV EXTERNAL VORTICES AND THEIR IMAGES INSIDE A BODY WITH	DM32	6
C	ELLIPTICAL CROSS SECTION. THEY ARE ADDED TO V AND W IN THE	DM32	7
C	ARGUMENT LIST.	DM32	8
C		DM32	9
C		DM32	10
C	DIMENSION VX(1),VY(1),G(1)	DM32	11
C		DM32	12
	COMMON/COM1/A2,B2,R2	DM32	13
	COMMON/COM2/SIG2,H2	DM32	14
C		DM32	15
C	COMPLEX T0,V1,DSDT,Z,DSDZ,S1,S1B,SU,TAU,C1,VEL	DM32	16
C		DM32	17
	EXTERNAL Z,DSDZ	DM32	18
	PI=3.14159265	DM32	19
	TLC=0.001	DM32	20
	C1=CMPLX(0.0,1.0)	DM32	21
	A2=AR*AR	DM32	22
	B2=BR*BR	DM32	23
	APB=AB*RB	DM32	24
	APH2=APB*APB	DM32	25
	R=0.5*APB	DM32	26
	H2=APB2	DM32	27
	R2=R*R	DM32	28
	SIG2=R2	DM32	29
	T0=CMPLX(VY,ZZ)	DM32	30
	S0=Z(T0)	DM32	31
	V1=CMPLX(0.0,0.0)	DM32	32
	DSDT=DSDZ(S0)	DM32	33
C		DM32	34
C	LOOP OVER THE NUMBER OF VORTICES,NV	DM32	35
C		DM32	36
	DO 1 I=1,NV	DM32	37
	TAU=CMPLX(VX(I),VY(I))	DM32	38

SI=Z(TAU)	DM32	39
SIB=CONJG(SI)	DM32	40
D=CABS(SI-SO)	DM32	41
IF(D,LE,TLC) GO TO 2	DM32	42
VI=V1-G(I)/(SO-SI)	DM32	43
2 CONTINUE	DM32	44
D=CABS(SO-R2/SIB)	DM32	45
IF(D,LE,TLC) GO TO 1	DM32	46
VI=V1+G(I)/(SO-R2/SIB)	DM32	47
1 CONTINUE	DM32	48
VEL=0.5*CI*V1*DSDT/PI	DM32	49
V=REAL(VEL)+V	DM32	50
W=A[MAG(VEL)+W	DM32	51
AV=ABS(V)	DM32	52
AW=ABS(W)	DM32	53
IF(V,GT,0.0,AND,AV,GE,VRTMAX) V=VRTMAX	DM32	54
IF(V,LT,0.0,AND,AV,GE,VRTMAX) V=-VRTMAX	DM32	55
IF(W,GT,0.0,AND,AW,GE,VRTMAX) W=VRTMAX	DM32	56
IF(W,LT,0.0,AND,AW,GE,VRTMAX) W=-VRTMAX	DM32	57
RETURN	DM32	58
END	DM32	59

COMPLEX FUNCTION Z(CT)	DM33	1
VERSION: DEMON1	DM33	2
VERSION: DEMON1	DM33	3
THIS FUNCTION SUBROUTINE CALCULATES THE SIGMA VALUE IN THE	DM33	4
TRANSFORMED (CIRCLE) PLANE FOR GIVEN TAU IN THE PHYSICAL PLANE	DM33	5
FOR AN ELLIPTICAL BODY WITH WINGS	DM33	6
COMMON/COM2/SIG2,H2	DM33	7
COMMON/COM3/ZR,ZI	DM33	8
COMMON/COM4/G2,G1	DM33	9
COMMON/COM6/W2,*	DM33	10
COMPLEX W,G1,G2,CT,W2,DBLU	DM33	11
EXTERNAL DBLU	DM33	12
W=DBLU(CT)	DM33	13
G1=W+SIG2/W	DM33	14
G2=G1+G1-H2	DM33	15
Y=AIMAG(G2)	DM33	16
AY=1.0	DM33	17
IF(Y,LT,0.0) AY=-1.0	DM33	18
YZ=AIMAG(G1)	DM33	19
AYZ=1.0	DM33	20
IF(YZ,LT,0.0) AYZ=-1.0	DM33	21
G2=CSQRT(G2)*AY*AYZ	DM33	22
IF((ABS(YZ),LE,0.0),AND,(REAL(G1),LT,0.0)) G2=CMPLX(-REAL(G2),	DM33	23
AIMAG(G2))	DM33	24
Z=0.5*(G1+G2)	DM33	25
IF((ABS(ZI),NE,0.0),AND,(ABS(ZH),NE,0.0)) Z=CMPLX(ZP+ABS(REAL(Z)),	DM33	26
IZI+ABS(AIMAG(Z)))	DM33	27
RETURN	DM33	28
END	DM33	29

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### DESCRIPTION OF PROGRAM WDYBDY

#### INTRODUCTION

The purpose of this appendix is to describe the body source paneling program. Attention is given to the program's input, its output, the added special features to account for specified body nose shed vortices, and its interplay with program DEMON2 described in Appendix J. In relation to the work described in this report, program WDYBDY is employed to handle bodies in supersonic flow when they are elliptical in cross section.

Basically, the building blocks of this body modeling program have been extracted from Woodward's improved method described in reference 9 and documented in reference 10. Existing subroutines have been modified to account for combined angle of pitch and sideslip. Subroutines have been added to include effects of specified body nose vorticity in the calculation of pressures on the body.

This program performs the following tasks when the body of the configuration of interest is elliptical in cross section. First, the pressures acting on the forebody are calculated by this program including effects of specified body nose vortices if applicable. Second, the program has been arranged to compute velocity components induced by the body source panels at the control points distributed over the forward set of lifting surfaces (monoplane wing) and the associated body interference shell. If the length of body between the forward and tail lifting surfaces is long enough to influence the overall loads, program WDYBDY should be used to compute the pressure distributions over the afterbody. Effects of body nose and monoplane wing vortices must first be determined by program VPATHL which is described in Appendix L. This program computes the vortex paths along the afterbody. By means of an exchange of data sets with program WDYBDY, vortex induced velocity components are transferred to subroutine PRESS for inclusion in the calculation of pressures at points on the afterbody. Finally, this program calculates the velocity components induced by the body source panels at the control points of the tail lifting surfaces/interdigitated tails.

Thus, program WDYBDY, together with programs DEMON2 and VPATHL, is used repeatedly in accordance with the procedure described in Section 5.2.

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In this way, complete configurations involving bodies with elliptical cross section are handled.

The theoretical basis of program WDYBDY and its usage will be summarized. The calculation procedure, program operation, program limitations and termination conditions are described. Special debugging output options are discussed. Detailed descriptions of the program input and output are then given. Program listings appear at the end of this appendix.

### PROGRAM DESCRIPTION

A summary of the theory associated with body source panels is given in Section 4. Body source panels are distributed over the body surface as shown in figures 2 and 24. Panel orientation angles  $\delta$  and  $\theta$  are indicated in the sketch of Section 4.1. These panels model the body with elliptical cross section in supersonic flow.

Program WDYBDY is an adaptation of the computer program of reference 10. It has been specialized to flow model bodies with elliptic cross section. Body geometry can be specified in terms of the horizontal and vertical semiaxes FUSBY and FUSAZ as a function of axial distance from the body nose XFUS. The configuration can be pitched and rolled giving rise to angles of pitch and sideslip. The boundary condition and pressure equations have been extended to account for angle of sideslip in addition to angle of pitch, see Section 4. The force and moment calculations have also been modified to include angle of sideslip. Normal force and side force, as well as pitching moment and yawing moment are calculated in the body- and wind-axis coordinate systems. The subroutines affected by the changes involving the inclusion of effects of combined angle of pitch and sideslip are SOLVE, PRESS and FORMOM.

In addition, subroutines READVX, ELBDVT and VVELS have been included to read in body nose separation vortex positions and strengths as a function of axial distance and to compute their contributions to the velocity components used in the Bernoulli pressure expression, equation 10. In the latter process, a slender-body theory solution is used. The solution is concerned with the calculation of velocity components induced by a set of vortices at specified points in the presence of a body with

elliptical cross section. As such, the solution is a simplified version of the general solution described in Appendix I for the case involving a monoplane wing mounted on a body with elliptical cross section. Subroutine VVELS makes use of function subroutines DBLU, DSDZ and Z. The vortex induced velocity components are computed from expressions implemented in these routines using complex quantities.

A certain amount of graphical display can be generated through the use of routines PLOTG, PLOTA2, PLOTA3, PLOTA5, PLOTA6, PLOTA8 and PLOTV2. This capability serves as an aid in checking the input parameters that govern the geometrical layout of the body source panels. It also allows for an initial look at the pressure distributions on the body.

#### Calculation Procedure

The program calculations are blocked into four parts, each of which depends on the completion of the previous step but which do not interact with each other. The four major partitions of the calculations are: the generation of panel geometric properties, the calculation of the aerodynamic influence coefficients, the solution for the strengths, pressures and loadings and the calculation of velocities induced at specified set of control points. All data interchanged between these blocks is either saved in common or on external files. The basic program description is contained in reference 10. A flow chart of the subroutine flow sequence is shown in figure K-1.

In the geometry block of routine GEOM, the configuration is read by CONFIG. Body paneling may be computed for a subset of the geometry used to define the configuration. NEWRAD is used to redefine the meridional lines describing the panel side edges and BODPAN both redefines the x-spacing of the panels and computes the panel corner points and inclination angles  $\delta$  and  $\theta$ . The geometry description is saved on TAPE 7. If vortices are to be accounted for, the x-location at which vorticity characteristics are given are read from READVX before calling NEWRAD. If the control points are to be saved for use by other programs, a table of panel control points is written on TAPE 4 at the completion of the generation of the geometry.

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The generation of the aerodynamic matrix coefficients is organized in VELCMP. The velocity contributions and influences between panels are computed by BODVEL and SORPAN. The aerodynamic matrix and velocities are saved on files TAPE 8, TAPE 9, and TAPE 10.

The solution of the equations and the calculation of pressures and forces is governed by routine SOLVE. The flow tangency boundary condition is defined and the solution of the equations is computed by a combination of routines DIAGIN, PARTIN, ITRATE and INVERT. The contribution to the velocity components from external vortices is included by either interpolation in a vortex strength table or by directly reading the contributions computed by external programs such as program VPATHL described in Appendix L. The pressure coefficient on each panel and the forces and moments acting on the body are then computed in PRESS and FORMOM, respectively. If the integration of the forces and moments over the length of body between specified x-locations XSTART and XWLE is required, the force and moment calculations are repeated for that length of body.

The last calculation block is performed when the calculation of velocity components at specified control points is requested. The velocity components in the body coordinate directions are computed using the solution strengths obtained in the previous part. No contribution due to vorticity is included in this calculation. The velocities are written after the control points on TAPE 4 for transmittal to program DEMON2 described in Appendix J in accordance with the procedures given in Section 5.2.

### Program Operation

The body modeling program using source panels on the surface is written in FORTRAN IV language (029 punch) and has been run on a CDC 6600 machine. The program is an adaptation of the wing-body-tail program in reference 10 simplified to body-only modeling. The program is arranged so that a total of 600 source panels are available to cover the body surface. The current version requires 122000 octal core locations to run on the CDC 6600.

The program requires seven disk files for operation. Because of the input copy feature of the program, the normal program input is read



from TAPE 5 and not the INPUT tape. The normal input file may not be re-wound. TAPE 4 may be used for either of three functions. If NWCPT is greater than one, specified control points are read from TAPE 4, velocities computed and written after the control points on TAPE 4. If NCPOUT is equal to one, the control points associated with the body source panels aft of XSTART and forward of XWLE are written on TAPE 4. If NVLIN is equal to one, the velocity components calculated by program VPATHL for control points aft of XSTART and forward of XWLE are read from TAPE 4. Files TAPE 7, TAPE 8, TAPE 9, and TAPE 10 are used to store intermediate results required for the solution of the aerodynamic matrix.

### Programs Limitations

The body modeling program has several limitations due to current code dimensions and due to the limitations inherent to the linear theory. The code will handle up to 600 body source panels during solution. There is a further limitation with regard to the number of panels in a given ring and the total number of rings. The maximum number of panels on the half body for symmetric cases and on the full body for nonsymmetric cases is restricted to 20 panels on a single ring. Similarly, the maximum number of rings of panels in the axial direction is limited to thirty. The flow limitation on the code is that the angle of inclination of all panels be less than the vertex angle of the Mach cone at supersonic speeds. No provisions are incorporated in the program for the presence of detached shocks. A summary of the program termination conditions that are checked for in the code follows. When body nose vortices are present, up to ten vortices may be handled simultaneously. When the calculation of velocities are performed at external field points, a maximum of 600 field point coordinates may be read in at a time.

### Program Termination Conditions

A number of labeled STOP conditions exist in the program. These may exist as a result of error conditions or end-of-data checks. They are as follows:

STOP	Routine	Description
STOP 20	GEOM	Normal program termination for end of data on TAPE 5.

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STOP	Routine	Description
STOP 200	GEOM	Error - body has more than 20 columns panels around circumference.
STOP 120	NEWRAD	Error - body has more than 20 meridians.
STOP 130	NEWRAD	Error - body has more than 60 axial stations.
STOP 20	BODPAN	Error - number of rows of source panels in section exceeds 30.
STOP 30	BODPAN	Error - number of rows of source panels on body exceeds 30.
STOP 500	PRTCPT	Termination for NCPOUT equals 2.
STOP 210	SORPAN	Panel slope exceeds Mach cone angle.

### Supplementary Print from CDUMP

The routine CDUMP was written to provide additional print of variables in common for debugging purposes during execution. It is called at several points within the program as specified by the print controls IPRT. The information is printed according to the value of the option as follows:

Value	Supplementary print
0	Prints only name of routine from which called.
1	Prints variables and arrays of less than 11 in length for common blocks: JOPTNS, PARAM, NEWCOM, VELCOM, and SEG.
2	Prints all of above common blocks.
3	Prints variable array BLOCK in unlabelled common.
4	Prints variables array ARRAY in common block POINT.
5	Prints common block COMPS.
6	Prints common block TRAN.
7	Prints common block BTHET
8	Prints common blocks COEF, MATCOM, and ITERAT.

Note for print control IPRINT = 0, no print is output.

## Description of Configuration Geometry Input Cards

The configuration geometry input defines the external shape of the body only. The auxiliary geometry input later defines the sequence to be used in paneling the configuration by interpolation in the external geometry. The input description used here was adapted directly from reference 10 where it is used to describe an entire configuration. In all cases the original definitions have been preserved. For certain options additional meanings have been attached.

## WDYBDY Program Input Data

This program was adapted from the body analysis portion of the program detailed in reference 10. Herein, the geometric variables and their definitions used to describe the body have been maintained wherever possible. Several additional cards have been added to the program to facilitate the input of new program options and the description of parameters associated with discrete vortex properties. An additional input file used to exchange control points and velocities is also required. The original description of the cards and documentation in reference 10 has been maintained for simplicity. A sample input deck is described in Section 6.2 and shown in figure 25.

The input to the program consists of four parts: the definition of program options associated with printing, plotting and vortex options; the numerical description of the configuration geometry; an auxiliary data set specifying the singularity paneling scheme and program options; and the case cards defining the Mach number, combined angle of attack and roll, and vortex locations and strengths.

The definition of the coordinate axes used in this program is defined in figure 2. The  $x_B$ ,  $y_B$  and  $z_B$  axes in figure 2 correspond to the  $x_B$ ,  $y_B$ , and  $z_B$  axes used in program DEMON2 and shown in figure 1. The body is considered to be viewed facing forward with the positive  $x_B$ -axis aft, the positive  $y_B$ -axis out the right and the positive  $z_B$ -axis up. In the following, the B-subscript is omitted wherever the body coordinates are mentioned.

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### Descriptions of Input Option Cards

The options defined here control supplementary output and online plotting not defined by IPRINT and the specification of special control point and vortex options. The latter variables control the additional input to be read in later.

Card 1 - Title card - Card 1 contains any desired identifying information in columns 1-80.

Card 2 - Option Integers - Card 2 contains 14 integers, each punched right justified in a 3-columnar field (14I3). Columns 73-80 may be used in any desired manner. It is designated the IPRT card for reference. Subroutine CDUMP referenced to in the following in connection with print control IPRT is discussed above as part of the program description. Card 2 reads the following:

<u>Column</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
1-3	IPRT(1)	0	Do not print copy of input
		1	Print formatted copy of input data
4-6	IPRT(2)	0	No supplementary print after GEOM
		>0	Call CDUMP for special print after GEOM
7-9	IPRT(3)	0	No supplementary print of vortices
		1	Print supplementary information after calculation of vortex velocity components
10-12	IPRT(4)	0	No supplementary print after VELCMP
		>0	Call CDUMP for special print after VELCMP
13-15	IPRT(5)	0	No supplementary print after SOLVE
		>0	Call CDUMP for special print after SOLVE
16-18	IXZSYM	0	Panel only symmetric half of configuration
		1	Panel full configuration symmetrically using geometry of positive y side.
		-1	Panel full configuration by reading geometry of both sides
19-21	IPLOT(1)	0	Do not plot geometry
		1	Plot three orthographic projections and perspective of geometry of panel layout on line printer

<u>Column</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
22-24	IPLOT(2)	0	Do not plot CP
		1	Plot CP at each control point versus x location and versus meridional angle $\theta$
25-27	IPLOT(3)	0	Not available
28-30	IPLOT(4)	0	Not available
31-33	NWCPT	0	Do not call BDYVEL. TAPE 4 input is not required
		1-600	NWCPT values of I, XPT, YPT, ZPT control points are read from TAPE 4 and velocities induced by body source panels computed at these coordinates
		-1	NBODY values of XPT, YPT, ZPT control points are generated internally and velocities computed to test routine BDYVEL. TAPE 4 is not used. NBODY is the total number of source panels distributed over the body surface
34-36	NVTX	0	No body nose vortex strengths or Y and Z location data is read. All vortex contributions to velocities are set to zero
		1-10	Vortex Y and Z locations, YVRTX and ZVRTX, and strengths, $\Gamma/V$ are read for each of NXVTX x-stations, XV. Three cards are read for each vortex
37-39	NXVTX	0	No body nose vortex x-station data is read. All vortex contributions to velocities are set to zero
		1-10	Body nose vortex x-body stations are read. These x values define the stations at which vortex Y, Z and $\Gamma/V$ data will be read. One XV card is to be read. Maximum number of x-stations is 10
40-42	NCPOUT	0	No control points are output on TAPE 4
		1	X,Y,Z body control points aft of XSTART and forward of XWLE are written in (I5, 3E12.5) format on TAPE 4. Conversely, options specified by NWCPT and NVLIN will not work
		2	Same function as NCPOUT = 1 except program execution is terminated at that point
43-45	NVLIN	0	No vortex velocities are read

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<u>Column</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
		1	Body source panel control point and V and W data are read for each of the x-stations aft of XSTART and forward of XWLE from TAPE 4 as defined previously for NCPOUT = 1. XCP, YCP, ZCP, VA and WA are read in (I5, 5E12.5) for each of the x-stations. Conversely, options defined by NWCPT and NCPOUT will not work.

Card 3 - Option X-stations - Card 3 contains two real numbers punched in a 7-column field (2F7.0). Columns 73-80 may be used to identify the card. It is designated the XWLE card for reference. Card 3 reads the following:

<u>Column</u>	<u>Variable</u>	<u>Description</u>
1-7	XWLE	x-station of wing root chord leading edge. This variable has two meanings: 1) For NWCPT>0, XWLE is the reference distance from zero of the body axis coordinate system to the reference zero of the lifting surfaces whose control points are to be read from TAPE 4. It is added to the x-values read for the control points. 2) For NCPOUT = 1 or NVLIN=1, XWLE is the aft boundary of control points to be output or read in. It would correspond to the leading edge of the wing or tail surface root chord.
8-14	XSTART	x-station of start of region of additional velocity influence. For NCPOUT=1 or NVLIN=1, XSTART is the forward boundary of control points for which additional velocity components are computed or read in and control points calculated

Note: The special force calculation computes the loadings acting on the body panels with control points between x-locations XSTART and XWLE. For this calculation to be valid between these values, the user should also make the x-locations of appropriate panel leading or trailing edges correspond to the XSTART and XWLE locations as prescribed on the XFUSK card.

The geometry of the configuration may either be symmetrical or non-symmetrical about the y-0 plane (the plane of symmetry). The original configuration definition, which allowed only the description of symmetric

configurations, may be used to define only one side of the configuration or to define a paneling sequence for both sides. The input of both sides of the geometry is also allowed. The convention used in this program for definition of a symmetric configuration is to present that half of the configuration located on the positive y side of the  $y=0$  plane. The number of input cards depends on the number of segments and the amount of detail used to describe each component. In connection with the work described in this report, disregard all references to wings, tails, and pods.

Card 4 - Control integers - Card 4 contains 24 integers, each punched right justified in a 3-column field. Columns 73-80 may be used in any desired manner. It is designated the JCARD in the data deck for reference. Card 4 contains the following:

<u>Column</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
1-3	J0	0	No reference area
		1	Reference area to be read in
4-6	J1	0	Wing data option - not available
7-9	J2	0	No fuselage data
		1	Data for arbitrarily shaped fuselage to be read
		-1	Data for circular fuselage in form of cross sectional areas versus XFUS to be read
		-2	Data for circular fuselage in form of radii versus XFUS to be read
		-3	Data for elliptic fuselage in form of semi-axis in y-direction and semi-axis in z-direction to be read (With $J6=0$ , fuselage will be cambered. With $J6=-1$ , fuselage will be symmetrical with xy-plane. With $J6=1$ , entire configuration will be symmetrical with $y=0$ plane.)
10-12	J3	0	Pod data option - not available
13-15	J4	0	Fin data option - not available
16-18	J5	0	Canard (horizontal tail) option - not available
19-21	J6	0	A cambered circular or arbitrary fuselage if J2 is nonzero. Read ZFUS data cards (described later under fuselage data cards)

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<u>Column</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
		1	Complete configuration is symmetrical with respect to xy-plane, which implies an uncambered circular fuselage
		-1	Uncambered circular fuselage with J2 nonzero
22-24	NWAF	0	Number of airfoil sections - not available
25-27	NWAFOR	0	Number of airfoil ordinates - not available
28-30	NFUS	1-4	Number of fuselage segments
31-33	NRADX(1)	3-30	Number of points used to represent the first fuselage segment about the circumference. If the configuration is symmetric (IXZSYM=0,1) NRADX is input for the half section. If the entire configuration is input (IXZSYM=-1) NRADX is input for the full section. If fuselage is circular, the program computes the indicated number of y- and z-ordinates
34-36	NFORX(1)	2-30	Number of x-stations for first fuselage segment
34-39	NRADX(2)	3-30	Same as NRADX(1), but for second fuselage segment
40-42	NFORX(2)	2-30	Same as NFORX(1), but for second fuselage segment
43-45	NRADX(3)	3-30	Same as NRADX(1), but for third fuselage segment
46-48	NFORX(3)	2-30	Same as NFORX(1), but for third fuselage segment
49-51	NRADX(4)	3-30	Same as NRADX(1), but for fourth fuselage segment
52-54	NFORX(4)	2-30	Same as NFORX(1), but for fourth fuselage segment
55-57	NP	0	Number of pods - not available
58-60	NPODOR	0	Number of pod stations - not available
61-63	NF	0	Number of fins - not available
64-66	NFINOR	0	Number of fin ordinates - not available
67-69	NCAN	0	Number of canards - not available
70-72	NCANOR	0	Number of canard ordinates - not available



Card 5,6,... - remaining input data cards - The remaining input data cards contain a detailed description of the body component configuration. Each card contains up to 10 values, each value punched in a 7-column field with a decimal point (10F7.0 format) and may be identified in columns 73-80. The cards are arranged in the following order as required by the above options: reference area card and fuselage data cards.

Reference area card: The reference area value is punched in columns 1-7 and may be identified as REFA in columns 73-80.

Fuselage data cards: The first card (or cards) specifies the x-values of the fuselage stations of the first segment. There will be NFORX(1) values and the cards may be identified in columns 73-80 by the symbols XFUSJ where J denotes the number of the last fuselage station given on that card. If the fuselage is cambered ( $J2 < 0$ , and  $J6 = 0$ ) the z-values of the fuselage centerline are read next. There will be NFORX(1) values of z at the above x-stations.

If the fuselage is circular or elliptical, the next card (or cards) is specified according to option J2. If  $J2 = -1$ , the card contains NFORX(1) values of fuselage cross-sectional areas and may be identified in columns 73-80 by the symbol FUSARDJ where J denotes the number of the last fuselage stations given on that card. If  $J2 = -2$ , the card contains NFORX(1) values of fuselage section radii, and may be identified in columns 73-80 by the symbol FUSRADJ. If  $J2 = -3$ , two cards (or sets of cards) containing the elliptic body horizontal and vertical semi-axes are given. The first is the horizontal semi-axis and is designated by the symbol FUSBYJ. The second contains NFORX(1) values of the vertical semi-axis and is designated by the symbol FUSAZJ.

If the fuselage is of arbitrary shape, NRAD(1) values of the y-ordinates for a half section are given and identified in columns 73-80 as YJ where J is the station number. Following the y-ordinates are the NRADX(1) values of the corresponding z-ordinates for the half-section (or full section for IXZSYM = -1) identified in columns 73-80 as ZJ. Each station will have a set of y and z, and the convention of ordering the ordinates from bottom to top is observed. If the full section is given, the ordering continues from the top back to and including the bottom point to close the section.

## APPENDIX K

For each fuselage segment a new set of cards as described must be provided. The segment descriptions should be given in the order of increasing values of  $x$ .

### Description of Auxiliary Input Cards

Card 1 - Identification - Card 1 contains any desired identifying information in columns 1-80.

Card 2 - Boundary condition and control point definition - The specification of the lifting-surface boundary conditions are not applicable in the body alone version. This card also selects the output print options as originally described in reference 10. This card contains the following:

<u>Column</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
1-3	LINBC	0	Planar boundary condition - not available
4-6	THICK	0	Thickness option - not available
7-9	IPRINT	0	Print out the pressures and the forces and moments
		1	Print out option 0 and spanwise loads on the wing, fins, and canards
		2	Print out option 1 and the velocity components and source and vortex strengths
		3	Print out option 2 and the steps in the iterative solution
		4	Print out option 3 and the axial and normal velocity matrices

A negative value of print adds the panel geometry print out to the output indicated for options 1 through 4.

LINBC, THICK, and IPRINT are punched as right justified integers.

Card 3 - Revised configuration paneling description control integers - The contents of card 2 are punched as right justified integers as follows:

<u>Column</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
1-3	K0	0	No reference lengths
		1	Reference length data to be read

<u>Column</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
4-6	K1	0	No wing data - not available
7-9	K2	0	No body data
		1	Body data follows
10-12	K3		Not used
13-15	K4	0	No fin (vertical tail) data - not available
16-18	K5	0	No canard (horizontal tail) data - not available
19-21	K6		Not used
22-24	KWAF	0	Number of wing sections - not available
25-27	KWAFOR	0	Number of wing ordinates - not available
28-30	KFUS		The number of fuselage segments. The program sets KFUS = NFUS
31-33	KRADX(1)	0, 3-20	Number of meridian lines used to define panel edges on first body segment. There are three options for defining the panel edges. If KRADX(1) = 0, the meridian lines are defined by NRADX(1) in the geometry input. If KRADX(1) is positive, the meridian lines are calculated at KRADX(1) equally spaced PHIKs. If KRADX(1) is negative, the meridian lines are calculated at specified values of PHIK. For symmetric configurations (IXZSYM=0,1), KRADX is the number of meridians on the half-section. For full configurations (IXZSYM=1), KRADX is the number of meridians on the full section including meridians at 0° and 360°
34-36	KFORX(1)	0, 2-30	Number of axial stations used to define leading and trailing edges of panels on first body segment. If KFORX(1) = 0, the panel edges are defined by NFORX(1) in the geometry input
37-39	KRADX(2)	0, 3-20	Same as KRADX(1), but for second body segment
40-42	KFORX(2)	0, 2-30	Same as KFORX(1), but for second body segment
43-45	KRADX(3)	0, 3-20	Same as KRADX(1), but for third body segment
46-48	KFORX(3)	0, 2-30	Same as KFORX(1), but for third body segment

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<u>Column</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
49-51	KRADX(4)	0, 3-20	Same as KRADX(1), but for fourth body segment
52-54	KFORX(4)	0, 2-30	Same as KFORX(1), but for fourth body segment

The program is restricted to 600 body singularity panels. For this program there is an additional restriction that the total number of singularity panels in the axial direction on the body (fuselage) cannot exceed 30. The arbitrary body (fuselage) capability of this program is limited to those shapes for which the radius is a single-valued function of PHIK for each cross section of the body.

Card 4,5,... - remaining input data cards - The remaining input data cards contain a detailed description of the singularity paneling of each component of the configuration. Each card contains up to 10 values, each value punched in a 7-column field with a decimal point (10F7.0 format) and may be identified in columns 73-80. The cards are arranged in the following order as required by the above options: reference lengths, vortex x-station card, and fuselage (body) data cards.

Reference length card: This card may be identified as REFL in columns 73-80 and contains the following:

<u>Column</u>	<u>Variable</u>	<u>Description</u>
1-7	REFA	Wing reference area. If REFA = 0, the reference area is defined by the value of REFA in the geometry input
8-14	REFB	Wing semispan - not used
15-21	REFC	Wing reference chord - not used
22-28	REFD	Body (fuselage) reference diameter. If REFD = 0, a value of 1.0 is used for the reference diameter. This reference length is used to non-dimensionalize all moment coefficients
29-35	REFL	Body (fuselage) reference length. If REFL = 0, a value of 1.0 is used for the reference length
36-42	REFX	x coordinate of moment center
43-49	REFZ	z coordinate of moment center

Vortex x-station card: This card is read if NXVTX is greater than zero. It is identified in columns 73-80 by the symbol XV. This card contains NXVTX values (maximum is 10) of the x-stations at which vortex strength and location will be input later, XV. These locations constitute the table in which the strength of the vortices will be obtained for each control point on the body in order to compute the cross flow solutions due to the presence of discrete vortices. The first and last x-values in this table also constitute boundaries between which vortex solutions will be computed. Outside of this range of x-stations, the contribution of the vortices will be set to zero. The values XV are punched in up to ten 7-column fields (10F7.0 format). The interpolation is currently limited by dimensions to 10 values of XV.

Fuselage (body) data cards: If KRADX(1) is negative, the first body card is the body meridian angle card. This card contains KRADX(1) values of body meridian angle expressed in degrees and may be identified in columns 73-80 as PHIKJ where J denotes the body segment number. The convention is observed that PHIK = 0, is at the bottom of the body and PHIK = 180, is at the top of the body. Repeat this card for each fuselage segment.

If KFORX(1) is non-zero, the second body card is the body axial station card. This card contains KFORX(1) values of the x-ordinate of the body axial stations and may be identified in columns 73-80 as XFUSKJ where J denotes the body segment number. Repeat this card for each fuselage segment. If forces and moments are to be integrated between values of XSTART and XWLE, the panel boundaries specified in XFUSK should correspond to one or both of these values where appropriate.

If either of these cards are omitted, the program generates the values internally from the previous configuration definition.

#### Description of case control cards

Card 1 - Mach number and angle of attack card - This card may be identified in columns 73-80 as MALPHA and contains the following in three 7-column fields:

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<u>Column</u>	<u>Variable</u>	<u>Description</u>
1-7	MACH	The subsonic Mach number (including the value MACH = 0.) or the supersonic MACH number at which it is desired to calculate the aerodynamic data
8-14	ALPHAC	Included angle of attack at which it is desired to calculate the aerodynamic data, measured in degrees between the free-stream velocity vector and the body centerline
15-21	PHIR	Angle of roll, measured in degrees from the plane containing the free-stream velocity vector and the body centerline (the z-axis) positive clockwise

A value of MACH = -1 on this card signifies the termination of the present case. Geometry cards for a new case can follow such a terminal card.

Card 2,3,4... - Vortex strength and locations cards - If NVTX is greater than one, three cards are read for each of NVTX number of vortices. Each of the cards contains up to ten values punched in 7-column fields (10F7.0 format).

The first vortex card contains the y-location of the vortex at each of the x-stations on the XV card. There are NXVTX values on the card which is designated by the symbol YVRTXI where I is the vortex number in columns 73-80.

The second vortex card contains the z-location of the vortex at each of the x-stations on the XV card. There are NXVTX values on the card which is designated by the symbol ZVRTXI where I is the vortex number in columns 73-80.

The third vortex card contains the vortex strength divided by free stream velocity,  $\Gamma/V$ , of the vortex at each of the x-stations on the XV card. There are NXVTX values on the card which is designated by the symbol GAMI where I is the vortex number in columns 73-80.

A series of Mach number, angle of attack, and vortex card combinations for the same geometry may be calculated by repeating this sequence of case control cards with the desired values. If the case control sequence has been terminated by MACH = -1 on the MALPHA card an attempt

to read a new set of geometry will be made. The program will terminate if no cards exist by testing for the end of file.

### Description of Output

This section describes the minimum output for the body source panel program, WDYBDY. This output occurs when IPRINT = -3 and IPRT(1)=1 in the input. All primary output items are summarized here. The outputs associated with source panel properties is described in detail in reference 10 and will only be mentioned here. A sample is given in connection with the description of the second calculative example, Section 6.2 and figure 26. For general reference the subroutine names from which the print was made is written starting in column 110 between two asterisks for the first occurrence of print within a routine. Wherever possible these identifications will be used in specifying the output to be described.

The first page of output is the list of the input cards copied directly from TAPE 5, on which it is stored, as card images. The input is rewound after copying to the output file (TAPE 6), and read again by the program as needed.

The next two (or more pages) are a copy of the input data with its mnemonic name or function as it is read from the input. The output is in the following order: the run title and option summary read in GEOM, the vehicle geometry cards as read by CONFIG, and the paneling title card and options as read by GEOM. If NXVTX>0, routine READVX prints a summary of body x-stations (XV) as read from input and the horizontal and vertical semi-axes of an elliptic section at those stations (BY and AZ). The horizontal and vertical axes are computed by interpolation in the program input geometr.

The next page is a summary of the body panel corner point coordinates as generated in BODPAN. The x,y,z coordinates of each corner point of each panel is printed. The next page is a summary of the x, y, and z coordinates of the body source panel centroids. The next page is a summary of the body panel areas and inclination angles in radian and degrees. The angle DELTA is the inclination of the source panel to the body x-axis and the angle THETA is the angle between the leading edge

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of the panel and the body y-axis. These angle are indicated in the shock of Section 4.1. Additional output may be obtained for debugging purposes at the end of the geometry calculations as specified by the print options IPRT(2) and IPLOT(1).

The output from VELCMP is printed next summarizing the aerodynamic velocity matrix computations. The normal output is a summary of the numbers of panels and the CPU time required for the calculation of the velocity matrix coefficients. Output of the coefficients may be obtained from IPRINT=4. If the number of panels exceeds sixty, the solution vector is printed for intermediate iterations.

After the aerodynamic matrix has been computed a new case is begun from WDYBDY. This consists of the solution for the source strengths for a given Mach number, angle of attack,  $\alpha_c$ , and angle of roll,  $\phi$ . If the Mach number changes between cases, the program goes back to recompute the aerodynamic matrix.

The output from ELBDVT, concerned with body nose vorticity, is given next. A copy of the input y and z locations and the vortex strength,  $\Gamma/V$ , is printed first for the I'th vortex. This print is controlled by the option IPRT(1). A vortex interpolation table summarizing the strengths and locations of each of the discrete vortices to be used by VVELS in the computation of velocities induced by the nose separation vortices. The vortex trajectory is defined by XV, YVRTX, and ZVRTX for an elliptic body with horizontal and vertical semi-axes, BY and AZ. An additional debug output may be obtained for IPRT(3)=1 which summarizes the vortex properties at each of the control points as the velocities are computed.

The next page of output is printed from SOLVE summarizing the velocities on the body. For each of the panels the source strength, GB, and the axial, lateral and vertical velocity components, u, v, w, and the resultant inward normal, NB, due to only the source strength are given. In addition the velocity contributions due to discrete external vortices in the lateral and vertical directions, VA and WA, are printed. All velocity components are assumed to be positive in their respective positive coordinate directions. The sum of the contributions of the velocities due to source panels and discrete vortices is used in the calculation of pressures.



The next page of output is printed from FORMOM. It contains a summary of the forces on the panels due to the pressure acting on each of the panels. At each control point with coordinates  $X$ ,  $Y$ ,  $Z$ , and polar angle,  $THETP$ , measured positive counterclockwise from the positive  $y$ -axis, the pressure coefficient,  $CP$ , and the panel forces,  $CX$ ,  $CY$ , and  $CZ$  acting along the body coordinate axes, and the moments of these forces about the reference center about each of the axes,  $CLL$ ,  $CM$ , and  $CLN$ , are given. The pressure coefficient,  $CP$ , has a minimum value corresponding to zero static pressure, equation 11. The sense of the axial force,  $CX$ , is positive acting aft on the body; the force  $CY$  is positive acting to the right; and the force  $CZ$  is positive acting up. The pitching moment,  $CM$ , is positive nose up about the  $y$ -axis; the yawing moment,  $CLN$ , is positive nose right viewing downwards about the  $z$ -axis; and the rolling moment,  $CLL$ , is positive clockwise viewing forwards about the  $x$ -axis.

The total coefficients on the body are printed on the next page. These are the sum of the force components of the individual panels described above. The forces in the body coordinate system,  $CX$ ,  $CY$ , and  $CZ$  are normalized by the reference area,  $REFA$ . The moments,  $CM$ ,  $CLN$ , and  $CLL$ , have been normalized by the product of the reference area and the reference diameter,  $REFD$ . The moments are taken about the center,  $(REFX, 0, REFZ)$ . The  $x$ -location of the center of pressure,  $XCP$ , is printed as computed from the ratio,  $-CM/CZ$ . The force and moment coefficients are also specified in the wind axis system, see Section 4.2.

If distinct values of  $XSTART$  and  $XWLE$  have been specified the next two pages are a repeat of the previous two pages with the difference that only the forces and moments between  $XSTART$  and  $XWLE$  are computed. The total force coefficients are then the sum of the forces acting on panels between the above two variables. The program only checks on the location of control points within the  $x$ -range specified. For the integration to be valid the user must make the leading edges of the first ring of panels inside the range correspond to  $XSTART$  and the trailing edges of the last ring of panels in the range must correspond to  $XWLE$ . This is necessary since only the integration over whole panels is within the current capability of the program.

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The next page is printed when  $NWCPT \neq 0$ . It is a summary of the calculation of velocity components at specified field points. If  $NWCPT > 0$ , the field points are read from TAPE 4 as created by program DEMON2. If  $NWCPT < 0$ , the control points for panels generated within WDYBDY are used. In this case the velocities should reproduce the results first printed in SOLVE. The information printed by BDYVEL for each panel are the X, Y, Z of each field point at which the velocities is computed, the inclination angles, DELTA and THETA, and the velocity components, U, V, and W, in the coordinate axis directions, and the resultant outward normal velocity to the panel. The inclination angles  $\delta$  and  $\theta$  are defined either in the geometry definition. When the field points are read from TAPE 4 the angles are printed out as zero for the lack of better information.

This is the last page for a given case. The program will continue to read additional Mach number and  $\alpha_c$  cases or new configurations until the end of data is reached. The output also continues to repeat as specified. The use of TAPE 4, however, is not organized to handle multiple cases at this time.

### PROGRAM LISTINGS

The body modeling program is written in FORTRAN IV (029 punch) computer language for the CDC 6600 computer. The program consists of a main program, WDYBDY, and 42 subroutines. A listing of the program subroutine names in alphabetical order follows.

#### PROGRAM WDYBDY

<u>ROUTINE</u>	<u>IDENTIFICATION</u>	<u>PAGE NO.</u>
	col 73-76	
1. WDYBDY (main program)	WB01	312
2. BDYVEL	WB02	313
3. BODPAN	WB03	317
4. BODVEL	WB04	319
5. CDUMP	WB05	322
6. CPUTIM	WB06	324
7. COMCU	WB07	325

<u>ROUTINE</u>		<u>IDENTIFICATION</u>	<u>PAGE NO.</u>
		col 73-76	
8.	CONFIG	WB08	326
9.	CUBIC2	WB09	333
10.	DBLU	WB10	333
11.	DERIV	WB11	334
12.	DERIV1	WB12	334
13.	DERIV2	WB13	334
14.	DIAGIN	WB14	335
15.	DSDZ	WB15	336
16.	DZDS	WB16	336
17.	ELBDVT	WB17	336
18.	FORMOM	WB18	338
19.	GEOM	WB19	342
20.	INVERT	WB20	345
21.	ITRATE	WB21	346
22.	MXOUT	WB22	349
23.	NEWRAD	WB23	351
24.	PANEL	WB24	353
25.	PARTIN	WB25	356
26.	PLOTA2	WB26	357
27.	PLOTA3	WB27	360
} Note: these subroutines are to be stored in LIBRARY (PLOTS) called by VPATH2, VPATHL, WDYBDY			
28.	PLOTA5	WB28	363
29.	PLOTA6	WB29	363
30.	PLOTA7	WB30	365
31.	PLOTA8	WB31	366
32.	PLOTG	WB32	370
33.	PLOTV2	WB33	372
34.	PRESS	WB34	376
35.	PRTCPT	WB35	377
36.	READVX	WB36	378
37.	RDVEL	WB37	379

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<u>ROUTINE</u>	<u>IDENTIFICATION</u> col 73-76	<u>PAGE NO.</u>
38. SCAMP4	WB38	379
39. SOLVE	WB39	380
40. SORPAN	WB40	384
41. VELCMP	WB41	386
42. VVELS	WB42	389
43. Z	WB43	390

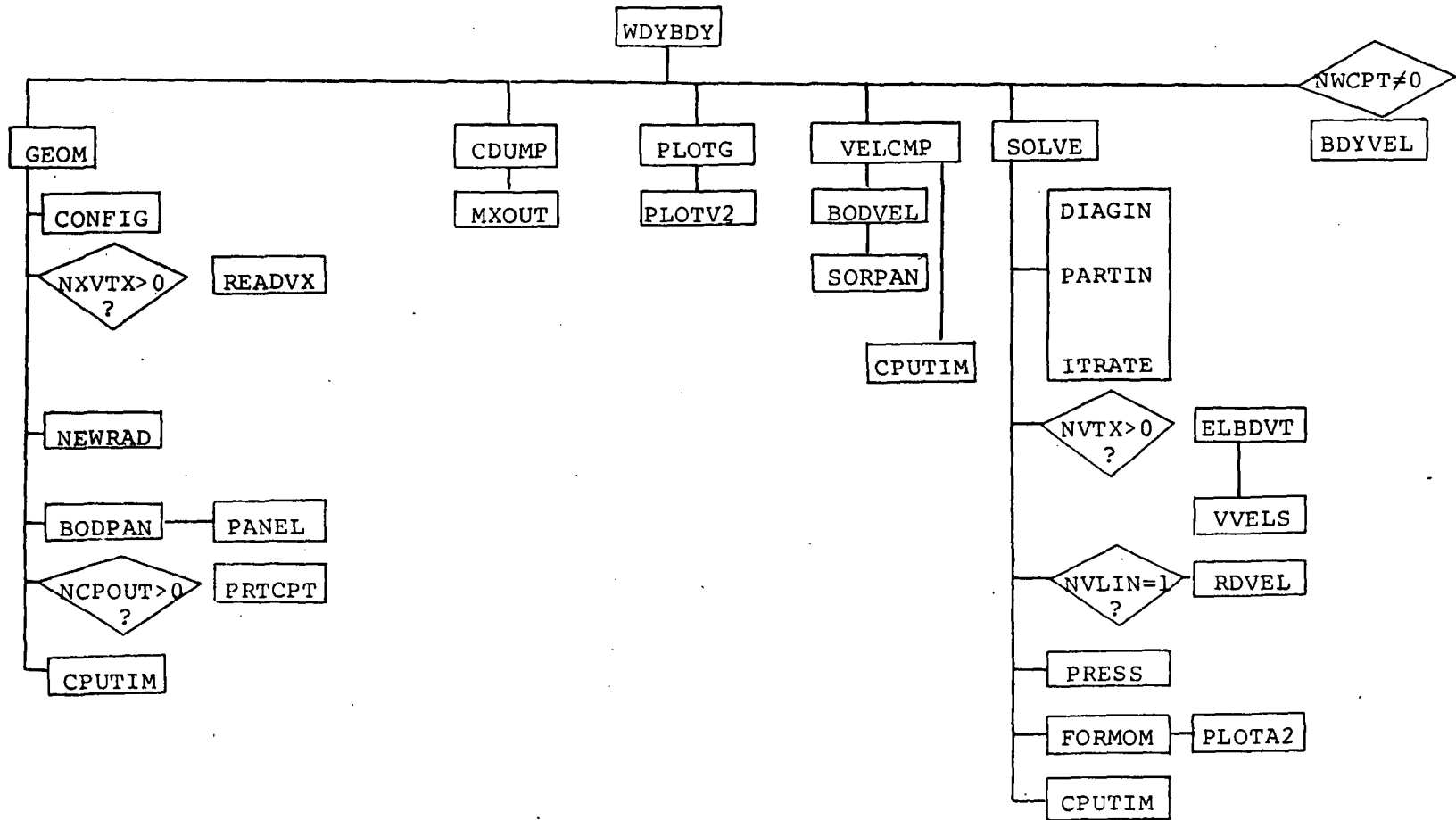


Figure K-1.- Program Subroutine Flow

PROGRAM WDYBDY

PROGRAM WBYBODY(OUTPUT,TAPE6=OUTPUT,TAPE4,TAPE5,TAPE7,	WR01	1
1 TAPE8,TAPE9,TAPE10)	WR01	2
C PROGRAM WBYBODY(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE7,	WR01	3
CDC OVERLAY(L=8,0,0)	WR01	4
C	WR01	5
C -----	WR01	6
C BODY ONLY VERSION: JOE MULLEN, JUNE, 1977	WR01	7
C -----	WR01	8
C	WR01	9
C PROGRAM WBYBODY COMPUTES THE SUBSONIC AND SUPERSONIC POTENTIAL	WR01	10
C FLOW AERODYNAMIC CHARACTERISTICS OF BODY CONFIGURATIONS.	WR01	11
C THE BODY IS REPRESENTED BY SOURCE PANELS.	WR01	12
C THE THEORY IS DESCRIBED IN NASA CR-2228 (PART I) AND THE	WR01	13
C COMPUTER PROGRAM IS DESCRIBED IN NASA CR-2228 (PART II).	WR01	14
C	WR01	15
C A CONVERGENCE CRITERIA TEST HAS BEEN INCORPORATED INTO SUBROUTINE	WR01	16
C ITRATE TO CONTROL THE ITERATIVE SOLUTION PROCEDURE, THE MAXIMUM	WR01	17
C NUMBER OF ITERATIONS AND THE CONVERGENCE CRITERIA TEST PARAMETER	WR01	18
C HAVE BEEN ADDED TO THE PROGRAM INPUT.	WR01	19
C	WR01	20
C THE FOLLOWING ARE LIMITATIONS OR KNOWN PROBLEMS	WR01	21
C	WR01	22
C THE PROGRAM IS INTENDED TO HANDLE 600 BODY PANELS,	WR01	23
C HOWEVER THE INPUT SPECIFIES CUTTING PLANES RATHER THAN	WR01	24
C PANELS WHICH MAY LIMIT THE INPUT TO DEFINING LESS THAN 600 PANELS.	WR01	25
C	WR01	26
C THE PROGRAM WILL NOT HANDLE NACELLES.	WR01	27
C	WR01	28
C THE TRAILING VORTEX SHEET FROM THE WING LEAVES THE TRAILING EDGE	WR01	29
C IN A PLANE PARALLEL TO THE X AXIS.	WR01	30
C	WR01	31
C COMMON /PARAM / NBODY,NWING,NTAIL,LHC,THK,XMACH,ALPHA,BETA,ALPHAC	WR01	32
1 ,PHIP,REFA,REFB,REFC,REFD,REFL,REFX,REFZ	WR01	33
C COMMON /VELCOM/ NPOINT,NPART,IMAX,JMAX,NHAX,EM,IPRINT,NKTHK	WR01	34
1 ,NARLOK,NARROW(20),NBBLOK,NBRROW(60)	WR01	35
C COMMON /JORTNS/ IZ1(60)	WR01	36
* ,NCPROT,XSTART,XALE,NWCPT,IPLUT(4),IPRT(5),IXZSYM	WR01	37
C DIMENSION ICARD(8)	WR01	38
C	WR01	39
C CALL CPUTIM(TIME,DT,0)	WR01	40
C ENB=1.	WR01	41
C XMACH=1.	WR01	42
C REWIND 5	WR01	43
C WRITE (6,90)	WR01	44
C WRITE (6,100)	WR01	45
C	WR01	46
C LIST INPUT CARDS	WR01	47
C	WR01	48
10 READ (5,110) ICARD	WR01	49
IF (END(5)) 30,20,30	WR01	50
20 WRITE (6,120) ICARD	WR01	51
GO TO 10	WR01	52
30 CONTINUE	WR01	53
REWIND 5	WR01	54
50 WRITE (6,70)	WR01	55
C	WR01	56
C INPUT CONFIGURATION GEOMETRY AND COMPUTE PANELS	WR01	57
C	WR01	58
C CALL GEOM	WR01	59
CDC CALL OVERLAY (L=8,1,0)	WR01	60
C	WR01	61
C GENERATE INTERMEDIATE PRINT AND PLOT GEOMETRY	WR01	62
C	WR01	63

CALL COMPP(IPRT(2),SHEND=GEOM).	WR01	64
IF (IPLOT(1),GT,0) CALL PLOT6	WR01	65
C INPUT MACH NUMBER AND COMPUTE AERODYNAMIC MATRIX	WR01	66
C A NEGATIVE MACH NUMBER IS USED TO TERMINATE MACH NUMBER AND ANGLE	WR01	67
C OF ATTACK CASES FOR A GIVEN GEOMETRY	WR01	68
C	WR01	69
60 CONTINUE	WR01	70
CALL VELCMP	WR01	71
CDC CALL OVERLAY (LWB,2,0)	WR01	72
CALL COMPP(IPRT(4),SHEND=VELC)	WR01	73
IF (XMACH,LT,0.) GO TO 50	WR01	74
WRITE (6,80)	WR01	75
C	WR01	76
C SOLVE RESULTING MATRIX EQUATIONS AND	WR01	77
C COMPUTE PRESSURES, FORCES, AND MOMENTS	WR01	78
C	WR01	79
CALL SOLVE	WR01	80
CDC CALL OVERLAY (LWB,3,0)	WR01	81
CALL COMPP(IPRT(5),SHEND=SOLV)	WR01	82
C	WR01	83
C COMPUTE ARBITRARY FIELD POINT VELOCITIES	WR01	84
C	WR01	85
IF (NOCPT,NE,0) CALL HOYVEL	WR01	86
GO TO 60	WR01	87
70 FORMAT (1H1,20X,25HBEGIN A NEW CONFIGURATION,64X,12H** WDYRDY **)	WR01	88
80 FORMAT (1H1,20X,16HBEGIN A NEW CASE,73X,12H** WDYRDY **)	WR01	89
90 FORMAT (1H1,10X,17H*****SOURCE PANEL BODY MODELING,	WR01	90
1 5H PROGRAM,10X,16HDATED JUNE, 1977)	WR01	91
100 FORMAT (1H0,25X,19HLIST OF INPUT CARDS//)	WR01	92
110 FORMAT (A10)	WR01	93
120 FORMAT (10X,A10)	WR01	94
END	WR01	95
	WR01	96

SUBROUTINE HOYVEL	WR02	1
C	WR02	2
C COMPUTE THE THREE COMPONENTS OF VELOCITY INDUCED AT SPECIFIED	WR02	3
C FIELD POINTS BY THE BODY PANELS. GIVEN THE STRENGTHS, GR, OF	WR02	4
C BODY SOURCE PANELS COMPUTE THE FLU VELOCITY COMPONENTS INDUCED	WR02	5
C BY BODY SOURCE PANELS AT SPECIFIED POINTS (I.E. WING MONOPLANE	WR02	6
C CENTROIDS)	WR02	7
C	WR02	8
COMMON /JOINTS/ IZ1(62),XWLE,VWCPT,IPLOT(4),IPRT(5),IXZSYM	WR02	9
COMMON /PARAM / NRODY,NWING,NTAIL,LRC,THK,XMACH,ALPHA,BETA,ALPHAC	WR02	10
1 ,PHIS,REFA,REFB,REFC,REFD,REFE,REFX,REFZ	WR02	11
COMMON /VELCMP/ VPOINT,IPART,IZH(2),XMAX,EN,IPRINT,NWTHK	WR02	12
1 ,NBLKX,NBRD*(20),NBLCK,NBRD*(60)	WR02	13
COMMON /KEXCOM/K1,KAF,KAFOR,KRAX(4),KFORX(4),KFUS,MAX,K4,K5	WR02	14
1 ,KF(6),KAC(6),KFINOR(6),KANOR(6),KOL,NCPPT,LCCPT(20),XCPT(20)	WR02	15
COMMON	WR02	16
1 ZR(600),XRT(600),YRT(600),ZRT(600),GR(600),GH(600),Z9(600)	WR02	17
COMMON /POINT / XPT(600),YPT(600),ZPT(600),THET(600),DELTA(600),	WR02	18
1 XC(30,20),YC(30,20),ZC(30,20),DELT(600),XLE(600)	WR02	19
COMMON /HODC IM/ AMACH,TAND,CX,XCOR(4),YCOR(4),ZCOR(4)	WR02	20
1 ,XI,YI,ZI,XJ,ZJ	WR02	21
COMMON /RTHET / THETA(600)	WR02	22
C	WR02	23
DIMENSION ARRAY(6000)	WR02	24



EQUIVALENCE	(XPT(1),ARRAY(1))	NR02	25
LOGICAL LHC		NR02	26
DATA RADDEG/0.0174532926/		NR02	27
DATA ICASE/0/		NR02	28
ICASE=ICASE+1		NR02	29
C		NR02	30
AMACH=XMACH		NR02	31
C		NR02	32
C READ BODY GEOMETRY COORDINATES		NR02	33
C		NR02	34
IF (NRBODY,LE.0) RETURN		NR02	35
REWIND 7		NR02	36
READ (7) ARRAY		NR02	37
DO 10 I=1,NRBODY		NR02	38
DELTA(I)=DELTA(I)		NR02	39
THETA(I)=THETA(I)		NR02	40
XBT(I) = XPT(I)		NR02	41
YBT(I) = YPT(I)		NR02	42
10 ZBT(I) = ZPT(I)		NR02	43
C		NR02	44
C READ WING CONTROL POINTS		NR02	45
C		NR02	46
IF (NWCPT,LT.0 .OR. ICASE,GT.1) GO TO 30		NR02	47
C		NR02	48
C IF NWCPT IS LESS THAN 0 USE BODY POINTS*		NR02	49
C IF NWCPT IS GREATER THAN 0 READ POINTS FROM INPUT FILE ON TAPE4		NR02	50
C		NR02	51
REWIND 4		NR02	52
READ (4,745) NWRP		NR02	53
READ (4,745) (J,XPT(I),YPT(I),ZPT(I),I=1,NWCPT)		NR02	54
DO 20 I=1,NWCPT		NR02	55
THET(I)=0.0		NR02	56
DELTA(I)=0.0		NR02	57
XPT(I)=XPT(I)+XWLE		NR02	58
20 CONTINUE		NR02	59
C		NR02	60
C FIND END OF CONTROL POINT DATA ON TAPE 4.		NR02	61
C		NR02	62
JP1=NWCPT+1		NR02	63
IF (NWRP,GT,NWCPT) READ (4,745) (J,XDUM,YDUM,ZDUM,I=JP1,NWRP)		NR02	64
30 IF (NWCPT,LT.0) NWCPT=NRBODY		NR02	65
C		NR02	66
C I IS THE INDEX OF THE FIELD POINT		NR02	67
C J IS THE INDEX OF THE INFLUENCING PANEL		NR02	68
C		NR02	69
WRITE(6,170)		NR02	70
C		NR02	71
C COORDINATES OF I-TH FIELD POINT		NR02	72
C		NR02	73
DO 110 I=1,NWCPT		NR02	74
SINTI=SIN(THET(I))		NR02	75
COSTI=COS(THET(I))		NR02	76
XPTI=XPT(I)		NR02	77
YPTI=YPT(I)		NR02	78
ZPTI=ZPT(I)		NR02	79
C		NR02	80
C BODY PANEL INCIDENCE ANGLE		NR02	81
C		NR02	82
SIND=SIN(DELTA(I))		NR02	83
COSD=COS(DELTA(I))		NR02	84
SUMU = 0.		NR02	85
SUMV = 0.		NR02	86
SUMW = 0.		NR02	87

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SUMN = 0.
J=0
JPN=0
I=0
DO 70 KFU=1,KFUS
  NRQ=KRADY(KFU)-1
  NCOL=KFCRX(KFU)-1
  DO 60 NC=1,NCOL
    L=L+1
    JPI=1+JPN
    JPN=JPI+NRQ*-1
    DO 50 N=1,NRQ
      J=J+1
      TAND=TAN(DELTA(J))
      COST=COS(THETA(J))
      SINT=SIN(THETA(J))
      XW=SINT*COSTI
      XX=COST*SINTI
      YW=COST*COSTI
      XZ=SINT*SINTI
      SINTR=X*-XX
      COSTR=XY*XZ
      NP1=N+1
      XC1=XC(L,NP1)
      YC1=YC(L,NP1)
      ZC1=ZC(L,NP1)
C
C  CALCULATION OF PANEL CORNER POINTS IN PANEL COORDINATE SYSTEM
C
      XCOR(1)=0.
      YCOR(1)=0.
      ZCOR(1)=0.
      XCOR(2)=XC(L+1,NP1)-XC1
      XCOR(3)=0.
      YCOR(4)=YCOR(2)
      DO 40 K=2,4
        LP1=L+1
        NP1=N+1
        IF (K.EQ.3) NP1=N
        IF (K.EQ.3) LP1=L
        DELY=YC(LP1,NP1)-YC1
        DELZ=ZC(LP1,NP1)-ZC1
        YCOR(K)=DELY*COST+DELZ*SINT
        ZCOR(K)=DELZ*COST-DELY*SINT
40    CONTINUE
      CX=XCOR(2)
C
C  CALCULATION OF FIELD POINT IN PANEL COORDINATE SYSTEM
C
      XI=XPFI-XC1
      YI=YPTI-YC1
      ZI=ZPTI-ZC1
      YI=OY*COST+OZ*SINT
      ZI=OZ*COST-OY*SINT
      XJEXHT(J)=XC1
      OYJEXHT(J)=YC1
      OZJEXHT(J)=ZC1
      ZJ=OZJ+COST=OYJ*SINT
C
C  CALCULATE VELOCITY COMPONENTS INDUCED BY CONSTANT SOURCE
C  DISTRIBUTION PANELS
C
      CALL SORPAN(UR,VR,WR)

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      WR02  88
      WR02  89
      WR02  90
      WR02  91
      WR02  92
      WR02  93
      WR02  94
      WR02  95
      WR02  96
      WR02  97
      WR02  98
      WR02  99
      WR02 100
      WR02 101
      WR02 102
      WR02 103
      WR02 104
      WR02 105
      WR02 106
      WR02 107
      WR02 108
      WR02 109
      WR02 110
      WR02 111
      WR02 112
      WR02 113
      WR02 114
      WR02 115
      WR02 116
      WR02 117
      WR02 118
      WR02 119
      WR02 120
      WR02 121
      WR02 122
      WR02 123
      WR02 124
      WR02 125
      WR02 126
      WR02 127
      WR02 128
      WR02 129
      WR02 130
      WR02 131
      WR02 132
      WR02 133
      WR02 134
      WR02 135
      WR02 136
      WR02 137
      WR02 138
      WR02 139
      WR02 140
      WR02 141
      WR02 142
      WR02 143
      WR02 144
      WR02 145
      WR02 146
      WR02 147
      WR02 148
      WR02 149
      WR02 150

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	UBJ=UR	WR02 151
	VIJ=VR+COSTR--R*SINTR	WR02 152
	WIJ=VR*SINTR+WR*COSTR	WR02 153
	UL=0.	WR02 154
	VL=0.	WR02 155
	WL=0.	WR02 156
C		WR02 157
C	CALCULATE VELOCITY COMPONENTS FROM LEFT SIDE FOR SYMMETRIC	WR02 158
C	CONFIGURATIONS INDUCED BY CONSTANT SOURCE PANEL	WR02 159
C		WR02 160
	IF (IXZSYN.EQ.0) GO TO 45	WR02 161
	SINTL=XX+XX	WR02 162
	COSTL=XY-YZ	WR02 163
	OY=-YPTI-YCI	WR02 164
	VI=OY*COST+OZ*SINT	WR02 165
	ZI=OZ*COST-OY*SINT	WR02 166
	CALL SORPAR(UL,VL,WL)	WR02 167
	UBJ=UBJ+UL	WR02 168
	VIJ=VIJ+VL*COSTL+WL*SINTL	WR02 169
	WIJ=WIJ+VL*SINTL+WL*COSTL	WR02 170
45	CONTINUE	WR02 171
C		WR02 172
C		WR02 173
	VRJ=VIJ+COSTI-WIJ*SINTI	WR02 174
	WBJ=WIJ+COSTI+VIJ*SINTI	WR02 175
	ANJ=WIJ+COSTO-URJ*SINO	WR02 176
	SUMU = SUMU+URJ*GB(J)	WR02 177
	SUMV = SUMV+VRJ*GB(J)	WR02 178
	SUMA = SUMA+ANJ*GB(J)	WR02 179
	SUMN = SUMN+ANJ*GB(J)	WR02 180
50	CONTINUE	WR02 181
60	CONTINUE	WR02 182
70	CONTINUE	WR02 183
C		WR02 184
C	COMPUTE VELOCITY AT I-TH FIELD POINT	WR02 185
C		WR02 186
	U(I) = SUMU	WR02 187
	V(I) = SUMV	WR02 188
	W(I) = SUMA	WR02 189
	ALPHA=ALPHA+RADDEG	WR02 190
	PHI=PHI+RADDEG	WR02 191
	SINAL=SIN(ALP)	WR02 192
	COSAL=COS(ALP)	WR02 193
	SINPH=SINAL*SIN(PHI)	WR02 194
	SINPH=SINAL*COS(PHI)	WR02 195
	WYI=COSAL*SIN(DELTA(I))+COS(DELTA(I))*(-SINAL+COS(THET(I)))	WR02 196
	* +SINAL*SIN(THET(I)))	WR02 197
C		WR02 198
C		WR02 199
	WRITE(6,180) I,XPT(I),YPT(I),ZPT(I),THET(I),DELTA(I)	WR02 200
	* ,U(I),V(I),W(I),SUMN	WR02 201
110	CONTINUE	WR02 202
C		WR02 203
C	WRITE VELOCITIES INDUCED AT FIELD POINTS AFTER CONTROL POINT DATA	WR02 204
C	ON TAPE 4.	WR02 205
C		WR02 206
	WRITE(4,745) NWCPT,XMACH,ALPHAC,PHIR	WR02 207
	WRITE(4,745) (I,U(I),V(I),W(I),I=1,NWCPT)	WR02 208
	RETURN	WR02 209
C		WR02 210
170	FORMAT (1H1,10X,4HPERTURBATION VELOCITIES AT SPECIFIED CONTROL	WR02 211
	* 20H POINTS BY SOURCE PANELS ,31X,12H** BODYVEL **	WR02 212
	* ,//7X,13HCONTROL POINT,20X,12HPANEL ANGLES,10X,10HVELOCITIES,	WR02 213

	* //44 JCPT,5X,1HX,9X,1HY,9X,1HZ,7X,4HTHET,5X,5DELTA,AX,1HU	*H02 214
	* ,9X,1HV,9X,1HA,6X,ANORMAL/)	*H02 215
130	FORMAT(15,5F10,5,5F10,5)	*H02 216
745	FORMAT(15,3E12,5)	*H02 217
	END	*H02 218
	SUBROUTINE BODPAN	*H03 1
CCC	OVERLAY (LWH,1,5)	*H03 2
CCC	PROGRAM BODPAN	*H03 3
C		*H03 4
C	REVISE AXIAL SPACING ON BODY (FUSELAGE) AND COMPUTE NEW PANEL	*H03 5
C	GEOMETRY	*H03 6
C		*H03 7
	COMMON /JOPTNS/ IZ1(8)	*H03 8
1	,J0,J1,J2,J3,J4,J5,J6,KAF,KAFOR,NFUS,NRAX(4),NFORX(4)	*H03 9
2	,NR,NROR,NF,NFINR,NCAN,NCANOR,J2TEST,NK	*H03 10
3	,IZ2(34),IPRT(5),IXZSYM	*H03 11
	COMMON /PARAM / NR0Y,NWING,NTAIL,LHC,THK,WMACH,ALPHA,BETA,ALPHAC	*H03 12
1	,PHIR,REFR,REFC,REFD,REFL,REFY,REFZ	*H03 13
	COMMON BLOCK(7500)	*H03 14
	COMMON /POINT / ARRAY(6000)	*H03 15
	COMMON /EACOM/ K1,KAF,KAFOR,KRAX(4),KFORX(4),KFUS,KAX,K4,K5	*H03 16
1	,KF(6),KAN(6),KEINOR(6),KANOR(6),KOL,KCPT,LOCPT(20),XCPT(20)	*H03 17
	COMMON /VELCOM/ NPOINT,PAINT,IZ4(2),NMAX,EM,IPRINT,NTHK	*H03 18
1	,NBLK,NBROW(20),NBLK,NBROW(60)	*H03 19
	COMMON /XTHET / THETA(600)	*H03 20
C		*H03 21
	DIMENSION XR(30),YR(30,30),ZR(30,30),XJ(60),AREA(600),XPT(600),	*H03 22
1	YPT(600),ZPT(600),THET(600),DELTA(600),XC(30,20),YC(30,20),	*H03 23
2	ZC(30,20),XFUS(30,4)	*H03 24
C		*H03 25
	EQUIVALENCE (BLOCK(1),XFUS(1,1)), (BLOCK(121),YR(1,1))	*H03 26
1	, (BLOCK(5721),XR(1)), (BLOCK(1921),ZR(1,1))	*H03 27
	EQUIVALENCE (XPT(1),ARRAY(1)), (YPT(1),ARRAY(601))	*H03 28
*	, (ZPT(1),ARRAY(1201)), (THET(1),ARRAY(1801))	*H03 29
*	, (DELTA(1),ARRAY(2401)), (XC(1,1),ARRAY(3001))	*H03 30
*	, (YC(1,1),ARRAY(3601)), (ZC(1,1),ARRAY(4201))	*H03 31
*	, (AREA(1),ARRAY(4801))	*H03 32
C		*H03 33
	XIN(X1,Y1,X2,Y2,Y)=(X2-X1)*(Y-Y1)/(Y2-Y1)	*H03 34
C		*H03 35
	RAOFG=180./3.141592654	*H03 36
	REWIND 10	*H03 37
	IF (IPRINT,LT,0) WRITE (6,220)	*H03 38
C		*H03 39
C	CALCULATE COORDINATES OF PANEL CORNERS	*H03 40
C	JP = INDEX OF PANEL NUMBER (TOTAL=NRBODY)	*H03 41
C	JM = TOTAL NUMBER OF AXIAL STATIONS (MAX=30)	*H03 42
C		*H03 43
10	J=1	*H03 44
	LEU	*H03 45
	JP=0	*H03 46
	JM=0	*H03 47
	DO 120 NFUS=1,NFUS	*H03 48
	KFUSOR=KFORX(NFUS)	*H03 49
	NFUSOR=NFORX(NFUS)	*H03 50
	KRAD=KRAX(NFUS)	*H03 51
	KRAD=IABS(KRAD)	*H03 52
	IF (KRAD,EG,0) KRAD=NRAX(NFUS)	*H03 53

READ (10) XH,YH,ZH	WB03 54
IF (KFUSOR,EG,0) GO TO 20	WB03 55
C	WB03 56
C READ IN NEW AXIAL STATIONS (XJ) FOR BODY (FUSELAGE)	WB03 57
C	WB03 58
READ (5,210) (XJ(K),K=1,KFUSOR)	WB03 59
GO TO 50	WB03 60
20 KFUSOR=NFUSORX(NFU)	WB03 61
IF (KFUSOR.LE.30) GO TO 30	WB03 62
WRITE (6,190) NFU	WB03 63
STOP 20	WB03 64
C	WB03 65
C USE ORIGINAL AXIAL STATIONS XJ=XFUS	WB03 66
30 KFORX(NFU)=KFUSOR	WB03 67
DO 40 K=1,KFUSOR	WB03 68
XJ(K)=XFUS(K,NFU)	WB03 69
40 CONTINUE	WB03 70
50 JM=JM+KFUSOR	WB03 71
IF (JM.LE.30) GO TO 60	WB03 72
WRITE (6,200)	WB03 73
STOP 50	WB03 74
C	WB03 75
C INITIALIZE COORDINATES EQUAL TO SEGMENT LEADING EDGE	WB03 76
60 DO 70 K=1,KRAD	WB03 77
XC(J,K)=XB(1)	WB03 78
YC(J,K)=YB(1,K)	WB03 79
ZC(J,K)=ZB(1,K)	WB03 80
70 CONTINUE	WB03 81
C	WB03 82
C INTERPOLATE FOR REMAINING PANEL COORDINATES -----	WB03 83
DO 110 JJ=2,KFUSOR	WB03 84
JM1=J	WB03 85
J=J+1	WB03 86
C	WB03 87
C FIND X-STATION	WB03 88
C	WB03 89
DO 100 M=2,NFUSOR	WB03 90
MM1=M-1	WB03 91
IF (XH(M),LY,XJ(JJ)) GO TO 100	WB03 92
DO 90 K=1,KRAD	WB03 93
XC(J,K)=XJ(JJ)	WB03 94
YC(J,K)=YI(XH(MM1,K),XB(MM1),YB(M,K),XH(M),XJ(JJ))	WB03 95
ZC(J,K)=ZI(ZB(MM1,K),XB(MM1),ZB(M,K),XB(M),XJ(JJ))	WB03 96
IF (K.EQ.1) GO TO 90	WB03 97
KM1=K-1	WB03 98
JP=JP+1	WB03 99
C	WB03 100
C CALCULATE PANEL INCLINATION AND CENTROID	WB03 101
C	WB03 102
CALL PANEL(0,0,J,K,L,JP,AP)	WB03 103
C	WB03 104
C PRINT BODY PANEL COORDINATES	WB03 105
IF (IPRINT,GE,0) GO TO 80	WB03 106
WRITE (6,240) JP,XC(JM1,KM1),YC(JM1,KM1),ZC(JM1,KM1),XC(J,KM1),	WB03 107
1 YC(J,KM1),ZC(J,KM1),XC(JM1,K),YC(JM1,K),ZC(JM1,K),	WB03 108
2 XC(J,K),YC(J,K),ZC(J,K)	WB03 109
80 AREA(JP)=AP	WB03 110
90 CONTINUE	WB03 111
GO TO 110	WB03 112
100 CONTINUE	WB03 113
110 CONTINUE	WB03 114
120 CONTINUE	WB03 115
C	WB03 116

	NBODY=JP	WR03 117
	IF (NRBODY.GT.600) GO TO 170	WR03 118
	IF (IPRINT.GE.0) GO TO 150	WR03 119
	WRITE (6,250)	WR03 120
	DO 130 JP=1,NBODY	WR03 121
	WRITE (6,270) JP,XPT(JP),YPT(JP),ZPT(JP)	WR03 122
130	CONTINUE	WR03 123
	WRITE (6,280)	WR03 124
	DO 140 JP=1,NBODY	WR03 125
	DDEG=DELTA(JP)*RADEG	WR03 126
	TDEG=THET(JP)*RADEG	WR03 127
	WRITE (6,270) JP,AREA(JP),DELTA(JP),THET(JP),DDEG,TDEG	WR03 128
140	CONTINUE	WR03 129
150	DO 160 JP=1,NBODY	WR03 130
	THETA(JP)=THET(JP)	WR03 131
160	CONTINUE	WR03 132
C		WR03 133
C	STORE BODY GEOMETRY ON TAPE 7	WR03 134
C		WR03 135
	WRITE (7) ARRAY	WR03 136
	REWIND 10	WR03 137
	RETURN	WR03 138
170	WRITE (6,300)	WR03 139
	STOP	WR03 140
190	FORMAT (50H ERROR = NUMBER OF ROWS OF PANELS IN BODY SECTION	WR03 141
	1 15,2X,10H EXCEEDS 30)	WR03 142
200	FORMAT (49H ERROR = NUMBER OF ROWS OF SINGULARITY PANELS ON	WR03 143
	1 16H BODY EXCEEDS 30)	WR03 144
210	FORMAT (10F7.0)	WR03 145
220	FORMAT (1H1,9X,35H BODY PANEL CORNER POINT COORDINATES	WR03 146
	* 65X,12H** BODY PAN **///10X,5H1 AND	WR03 147
	1 60H 3 INDICATE BODY PANEL LEADING-EDGE POINTS, 2 AND 4 INDICATE	WR03 148
	2 21H TRAILING-EDGE POINTS/5X,5HPANEL,4(8X,1HX,8X,1HY,8X,1HZ)/	WR03 149
	3 19X,3(1H1,8X),3(1H2,8X),3(1H3,8X),3(1H4,8X)/)	WR03 150
240	FORMAT (18,4X,12F9.5)	WR03 151
250	FORMAT (1H1,39H BODY PANEL CENTROID POINT COORDINATES	WR03 152
	1 //4X,5HPOINT,4X,1HX,10X,1HY,10X,1HZ/15X,3(2HCP,9X)/)	WR03 153
	FORMAT (18,1X,4F11.5,F11.3)	WR03 154
270	FORMAT (1H1,4X,39H BODY PANEL AREAS AND INCLINATION ANGLES/	WR03 155
	1 1H0,3X,5HPANEL,2X,4HAREA,7X,5HDELTA,6X,5HTHETA,6X,5HDELTA,6X,	WR03 156
	2 5HTHETA/24X,3HRA0,8X,3HRA0,8X,3HDEG,8X,3HDEG/)	WR03 157
300	FORMAT (43H ERROR = NUMBER OF BODY PANELS EXCEEDS 600)	WR03 158
	END	WR03 159

	SUBROUTINE H00VEL	WR04 1
C		WR04 2
C	COMPUTE THE THREE COMPONENTS OF VELOCITY INDUCED AT SPECIFIED	WR04 3
C	CONTROL POINTS BY THE BODY PANELS	WR04 4
C		WR04 5
	COMMON /JOPTNS/ IZ1(73),IXZSY	WR04 6
	COMMON /PARAM / NBODY,NWING,NTAIL,LHC,THK,XMACH,ALPHA,BETA,ALPHAC	WR04 7
	1 PHIR,PEFA,REFB,REFC,REFD,REFL,REFX,REFZ	WR04 8
	COMMON /VELCOM/ NPOINT,NPART,IMAX,JMAX,NMAX,EM,IPRINT,NWTHK	WR04 9
	1 NWHLOK,NWRON(20),NWHLOK,NWRON(30)	WR04 10
	COMMON /NEWCOM/K1,KAP,KAPR,KRADX(4),KFORX(4),KFUS,KAX,K4,K5	WR04 11
	1 KF(6),KAN(6),KFINDR(6),KANOR(6),KNL,NCPT,LOCPT(20),XCPT(20)	WR04 12
	COMMON UB(600),VB(600),WB(600),VI(600),*I(600),AN(600),	WR04 13
	1 ON(60),ZB(240),XBT(600),YBT(600),ZBT(600),IT(600),Z9(1200)	WR04 14

	COMMON /PHINT / XPT(600),YPT(600),ZPT(600),THET(600),DELTA(600),	NR04	15
1	XC(30,20),YC(30,20),ZC(30,20),DELT(600),XLE(600)	NR04	16
	COMMON /HNDUOM/ AMACH,TAND,CX,XCOR(4),YCOR(4),ZCOR(4)	NR04	17
1	,XI,YI,ZI,XJ,ZJ	NR04	18
	COMMON /HTHET / THETA(600)	NR04	19
	LOGICAL LRC	NR04	20
	AMACH=XMACH	NR04	21
	JMAX=MAX	NR04	22
	II=0	NR04	23
C		NR04	24
C	I IS THE INDEX OF THE CONTROL POINT	NR04	25
C	J IS THE INDEX OF THE INFLUENCING PANEL	NR04	26
C		NR04	27
	DO 110 I=1,NPHINT	NR04	28
	IF (LRC .AND. I.EQ.IT(I) .AND. NPART.EQ.3) GO TO 110	NR04	29
	II=II+1	NR04	30
	SINTI=SIN(THET(I))	NR04	31
	COSTI=COS(THET(I))	NR04	32
	XPTI=XPT(I)	NR04	33
	YPTI=YPT(I)	NR04	34
	ZPTI=ZPT(I)	NR04	35
	IF (NPART.EQ.3) GO TO 10	NR04	36
C	BODY PANEL INCIDENCE ANGLE	NR04	37
	SIND=SIN(DELTA(I))	NR04	38
	COSD=COS(DELTA(I))	NR04	39
	GO TO 20	NR04	40
C	WING PANEL INCIDENCE ANGLE	NR04	41
10	DELT=0.	NR04	42
CNP	IF (.NOT.LRC) DELT=DELT(I)	NR04	43
	SIND=SIN(DELT)	NR04	44
	COSD=COS(DELT)	NR04	45
20	DO 30 J=1,NBODY	NR04	46
	UB(J)=0.	NR04	47
	VI(J)=0.	NR04	48
	WI(J)=0.	NR04	49
30	CONTINUE	NR04	50
	J=0	NR04	51
	JPN=0	NR04	52
	L=0	NR04	53
	DO 70 KFU=1,KFHS	NR04	54
	NR0=KXRAOX(KFU)=1	NR04	55
	ACOL=KFQRY(KFU)=1	NR04	56
	DO 60 NC=1,NCOL	NR04	57
	L=L+1	NR04	58
	JPI=1+JPN	NR04	59
	JPN=JPI+NR0=1	NR04	60
	DO 50 M=1,NROW	NR04	61
	J=J+1	NR04	62
	TAND=TAN(DELTA(J))	NR04	63
	COST=COS(THETA(J))	NR04	64
	SINT=SIN(THETA(J))	NR04	65
	X=SINT*COSTI	NR04	66
	XY=COST*SINTI	NR04	67
	XY=COST+COSTI	NR04	68
	XZ=SINT*SINTI	NR04	69
	SINTREX=X	NR04	70
	SINTLX=X	NR04	71
	COSTREX=XY+XZ	NR04	72
	COSTLX=X	NR04	73
	NPIS=NP+1	NR04	74
	XC1=XC(L,NP1)	NR04	75
	YC1=YC(L,NP1)	NR04	76
	ZC1=ZC(L,NP1)	NR04	77

C		4804	78
C	CALCULATION OF PANEL CORNER POINTS IN PANEL COORDINATE SYSTEM	4804	79
C		4804	80
	XCOR(1)=0.	4804	81
	YCOR(1)=0.	4804	82
	ZCOR(1)=0.	4804	83
	XCOR(2)=XC(L+1, NP1)-XC1	4804	84
	XCOR(3)=0.	4804	85
	XCOR(4)=XCOR(2)	4804	86
	DO 40 K=2,4	4804	87
	LP1=L+1	4804	88
	NP1=N+1	4804	89
	IF (K,GP,4) NP1=	4804	90
	IF (K,GP,3) LP1=L	4804	91
	OELY=YC(LP1,NP1)-YC1	4804	92
	OELZ=ZC(LP1,NP1)-ZC1	4804	93
	YCOR(K)=OELY*COST+OELZ*SINT	4804	94
	ZCOR(K)=OELZ*COST-OELY*SINT	4804	95
40	CONTINUE	4804	96
	CX=XCOR(2)	4804	97
C		4804	98
C	CALCULATION OF CONTROL POINT IN PANEL COORDINATE SYSTEM	4804	99
C		4804	100
	YI=YPTI-YC1	4804	101
	OY=YPTI-YC1	4804	102
	OZ=ZPTI-ZC1	4804	103
	YI=OY*COST+OZ*SINT	4804	104
	ZI=OZ*COST-OY*SINT	4804	105
	XJ=XRT(J)-XC1	4804	106
	OYJ=YRT(J)-YC1	4804	107
	OZJ=ZRT(J)-ZC1	4804	108
	ZJ=OZJ*COST-OYJ*SINT	4804	109
C		4804	110
C	CALCULATE VELOCITY COMPONENTS INDUCED BY CONSTANT SOURCE	4804	111
C	DISTRIBUTION PANELS	4804	112
C		4804	113
	CALL SORPAN(UR,VR,WR)	4804	114
	UR(J)=UR	4804	115
	VI(J)=VR+COSTR-UR*SINTR	4804	116
	WI(J)=VR*SINTR+UR*COSTR	4804	117
	UL=0.	4804	118
	VL=0.	4804	119
	WL=0.	4804	120
C		4804	121
C	CALCULATE VELOCITY COMPONENTS FROM LEFT SIDE FOR SYMMETRIC	4804	122
C	CONFIGURATIONS INDUCED BY CONSTANT SOURCE PANEL	4804	123
C		4804	124
	IF (IYZSYM,NE,0) GO TO 45	4804	125
	OY=-YPTI-YC1	4804	126
	YI=OY*COST+OZ*SINT	4804	127
	ZI=OZ*COST-OY*SINT	4804	128
	CALL SORPAN(UL,VL,WL)	4804	129
	UR(J)=UR(J)+UL	4804	130
	VI(J)=VI(J)-VL*COSTL+WL*SINTL	4804	131
	WI(J)=WI(J)+VL*SINTL+WL*COSTL	4804	132
45	CONTINUE	4804	133
C		4804	134
C	CALCULATE VELOCITY COMPONENTS IN ORIGINAL COORDINATE SYSTEM	4804	135
C		4804	136
	VR(J)=VI(J)+COSTI+WI(J)*SINTI	4804	137
	WR(J)=WI(J)+COSTI+VI(J)*SINTI	4804	138
	AR(J)=I(J)*COSD+UR(J)*SIND	4804	139
	IF (NPART,GT,1,OR,NBODY,LE,NMAX) GO TO 50	4804	140



	IF (II.LT.JP1.OR.II.GT.JPN) GO TO 50	WR04 141
	JS1=JP1	WR04 142
	JS2=JPN	WR04 143
	NS=NROW	WR04 144
50	CONTINUE	WR04 145
60	CONTINUE	WR04 146
70	CONTINUE	WR04 147
	JMAX=L	WR04 148
	IF (NBODY.LE.NMAX.OR.NPART.GT.1) GO TO 90	WR04 149
C		WR04 150
C	STORE DIAGONAL BLOCKS OF AERODYNAMIC MATRIX IN DN ARRAY	WR04 151
C		WR04 152
	DO K0 J=1,NBODY	WR04 153
	IF (J.LT.JS1.OR.J.GT.JS2) GO TO 80	WR04 154
	K=J-JS1+1	WR04 155
	DN(K)=AN(J)	WR04 156
	AN(J)=0.	WR04 157
80	CONTINUE	WR04 158
	WRITE (10) (DN(J),J=1,NS)	WR04 159
90	IF (IABS(IPRNT).LT.4) GO TO 100	WR04 160
	WRITE (6,160) II	WR04 161
	WRITE (6,120) NBODY	WR04 162
	WRITE (6,150) (UB(J),J=1,NBODY)	WR04 163
	WRITE (6,130) NBODY	WR04 164
	WRITE (6,150) (AN(J),J=1,NBODY)	WR04 165
	IF (NBODY.LE.NMAX.OR.NPART.NE.1) GO TO 100	WR04 166
	WRITE (6,140) NS	WR04 167
	WRITE (6,150) (DN(J),J=1,NS)	WR04 168
100	WRITE (5) (UB(J),VR(J),WR(J),J=1,NBODY)	WR04 169
	WRITE (9) (AN(J),J=1,NBODY)	WR04 170
110	CONTINUE	WR04 171
	RETURN	WR04 172
120	FORMAT (2X,10HUB(J),J=1,,I4)	WR04 173
130	FORMAT (2X,10HAN(J),J=1,,I3)	WR04 174
140	FORMAT (2X,10HDN(J),J=1,,I3)	WR04 175
150	FORMAT (1X,10F10,5)	WR04 176
160	FORMAT (1H0,22HAERODYNAMIC MATRIX, 1=,I3)	WR04 177
	END	WR04 178

	SUBROUTINE CDUMP(IPRNT,ROUTIN)	WR05 1
C		WR05 2
C	ROUTINE TO PRINT LABELED COMMON BLOCK DATA BY REQUEST.	WR05 3
C	INFORMATION TO BE PRINTED IS DETERMINED BY PRINT OPTION IPRNT.	WR05 4
C		WR05 5
C	PRINT CONTROL	WR05 6
C	IPRNT = 0 = PRINT ROUTINE NAME ONLY	WR05 7
C	= 1, PRINTS VARIABLES AND ARRAYS LESS THAN 11 IN LENGTH	WR05 8
C	FOR COMMON BLOCKS: JUPINS, PARAM, NEWCOM, VELCOM, + SEG	WR05 9
C	= 2, PRINTS ALL OF ABOVE COMMON BLOCKS	WR05 10
C	= 3, PRINT ARRAY BLOCK	WR05 11
C	= 4, PRINT VARIABLE = ARRAY	WR05 12
C	= 5, PRINTS COMMON: COMPS	WR05 13
C	= 6, PRINTS COMMON: TRAN	WR05 14
C	= 7, PRINTS COMMON: BTHET	WR05 15
C	= 8, PRINTS COMMON: COEF, MATCOM, + ITERAT	WR05 16
C	ROUTIN = HOLLERITH VARIABLE WITH NAME OF CALLING PROGRAM	WR05 17
C	SPECIFIED AS 8H-----.	WR05 18
C		WR05 19

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C7C DIMENSION ROUTIN(2)
C
COMMON /JOPTNS/ IZ1(8)
1 J0,J1,J2,J3,J4,J5,J6,KKAF,KWAFOR,NFUS,VRAOX(4),KFORX(4)
2 NP,NPDOR,NF,NFINOR,NCAN,NCANOR,J2TEST,NW,IZ2(25)
3 NVLIN,NCPINT,XSTART,XALE,KACPT,IPLUT(4),IPRT(5),IXZSYM
COMMON /PARAM / KADY,KWING,NTAIL,LBC,THK,XMACH,ALPHA,BETA,ALPHAC
1 PHIR,REFA,REFB,REFC,REFD,REFE,REFX,REFZ
COMMON /HEAD / TITLE1(2),TITLE2(2)
COMMON /SEG / NSFG,NROW(20),NCOL(20),CROSS(20),SINS(20)
1 RTE(20),NWT(20),SPN(20),XLEN(20),BLE(20),ZLE(20),ZB(60)
COMMON BLOCK(7500)
COMMON /PRINT / ARRAY(5000)
COMMON /NEACOM/ K1,KKAF,KWAFOR,KWAOX,KFORX,KFUS,MAY,K4,K5
1 KF(6),KAN(6),KFINOR(6),KANOR(6),KOL,NCPT,ICPT(20),XCPT(20)
COMMON /VELCOM/ NPOINT,NPART,IMAX,JMAX,NMAX,EM,IPRINT,NWTHK
1 NBLOK,NRBA(20),NBLOK,NHRU(60)
COMMON /COMPS / TCOMPS(11)
COMMON /TRAN / TTRAN(12)
COMMON /THET / THET(600)
COMMON /MATCHM/ MATIN
COMMON /CODEF / TCODEF(400)
COMMON /ITERAT/ ITMAX,CCTEST
C
IF (IPRINT,LE,0) RETURN
IF (IPRINT,GE,0) WRITE(6,10) ROUTIN
10 FORMAT(1H1,10X,31HCCOMMON BLOCK PRINT CALLED FROM ,AR)
C
IF (IPRINT,EQ,1 .OR. IPRINT,EQ,2)
* WRITE(6,15) J0,J1,J2,J3,J4,J5,J6,KKAF,KWAFOR
* ,NFUS,KWAOX,KFORX,NP,NPDOR,NF,NFINOR,NCAN,NCANOR
* J2TEST,NV,NVLIN,NCPINT,NWCPT,IPLUT,IPRT,IXZSYM
* ,KADY,KWING,NTAIL,LBC,THK,XMACH,ALPHA,BETA,ALPHAC,PHIR
* ,REFA,REFB,REFC,REFD,REFE,REFX,REFZ,XSTART,XALE
IF (IPRINT,EQ,1 .OR. IPRINT,EQ,2)
* WRITE(6,16) K1,KKAF,KWAFOR,KWAOX,KFORX,KFUS,MAY,K4
* ,KF,K5,KAN,KFINOR,KANOR,KOL,NCPT
* ,NPOINT,NPART,IMAX,JMAX,NMAX,IPRINT,NWTHK,NBLOK,NRBA
* ,EM,NSFG
15 FORMAT(/5X,15HCCOMMON /JOPTNS/
* ,/40H J0 J1 J2 J3 J4 J5 J6,/717
* ,/40H KKAF KWAFOR NFUS NRAOX (2) (3) (4),/717
* ,/40H NP NPDOR NF NFINOR NCAN NCANOR NF,/717
* ,/40H NVLIN NCAN NCANOR J2TEST NW NVLIN NCPINT,/717
* ,/40H NWCPT IPLUT (2) (3) (4) IPRT (2),/717
* ,/28H (5) (4) (5) IXZSYM,/417,
* ,/5X,15HCCOMMON /PARAM /
* ,/35H KADY KWING NTAIL LBC THK,/317,2L7
* ,/4X,5HXMACH,1X,5HAI PHA,2X,4HRETA,6X,6HALPHAC,2X,4HPHIR,/5G12,5
* ,/5X,4HREFA,2X,4HREFB,2X,4HREFC,2X,4HREFD,2X,4HREFE,/5G12,5
* ,/5X,4HREFX,2X,4HREFZ,2X,6HXSTART,2X,4HXALE,/4G12,5)
16 FORMAT(/5X,15HCCOMMON /NEACOM/
* ,/40H K1 KKAF KWAFOR KWAOX (2) (3) (4),/717
* ,/40H KFORX (2) (3) (4) KFUS MAY K4,/717
* ,/40H KF (2) (3) (4) (5) (6) K5,/717
* ,/7H KAN,/617
* ,/7H KFINOR,/617
* ,/7H KANOR,/617
* ,/14H KOL NCPT,/217
* ,/5X,15HCCOMMON /VELCOM/
* ,/40H NPOINT NPART IMAX JMAX NMAX IPRINT NWTHK,/717
* ,/21H NBLOK NRBA EM,/217,612,5
* ,/5X,15HCCOMMON /SEG /

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      * ,/7H NSEG,/17)
C
      IF (IPRNT, EQ, 2) WRITE(6, 20) IZ2
      IF (IPRNT, EQ, 2) WRITE(6, 21) NBROW, NCOL, COSS, SINS, BTE, NAT, SPNW, XLEW
      * ,/7H NSEG,/17)
      IF (IPRNT, EQ, 2) WRITE(6, 22) LUCPT, XCPT
      IF (IPRNT, EQ, 2) WRITE(6, 23) NAROW, NBROW
20  FORMAT(/5X, 6HARRAYS, /7H IZ2, 2(/10I5))
21  FORMAT(7H NROW, 2(/10I5))
      * ,/7H NCOL, 2(/10I5)
      * ,/7H COSS, 2(/10G12, 5)
      * ,/7H SINS, 2(/10G12, 5)
      * ,/7H BTE, 2(/10G12, 5)
      * ,/7H NAT, 2(/10I5)
      * ,/7H SPNW, 2(/10G12, 5)
      * ,/7H XLEW, 2(/10G12, 5)
      * ,/7H NLE, 2(/10G12, 5)
      * ,/7H ZLEW, 2(/10G12, 5)
22  FORMAT(7H LUCPT, 2(/10I5))
      * ,/7H XCPT, 2(/10G12, 5))
23  FORMAT(7H NAROW, 2(/10I5))
      * ,/7H NBROW, 6(/10I5))
C
C IPRNT=3 = ARRAY BLOCK
C
      IF (IPRNT, EQ, 3)
      * CALL MEXIT(8H COUNP , 1, BLOCK, 10, 750, 60, 132, 3, 10, 750)
C
C IPRNT=4, VARIABLE ARRAY
C
      IF (IPRNT, EQ, 4)
      * CALL MEXIT(8H COUNP , 1, ARRAY, 10, 600, 60, 132, 3, 10, 600)
C
C IPRNT=5, COMMON /COMPS/
      IF (IPRNT, EQ, 5) WRITE(6, 50) TCOMPS
30  FORMAT(/5X, 15HCOMMON /COMPS /, 2(/10G12, 5))
C
C IPRNT=6, COMMON /TRAN /
      IF (IPRNT, EQ, 6) WRITE(6, 35) TTRAN
35  FORMAT(/5X, 15HCOMMON /TRAN /, 2(/10G12, 5))
C
C IPRNT=7, COMMON /THET /
      IF (IPRNT, EQ, 7) WRITE(6, 40) THETI
40  FORMAT(/5X, 15HCOMMON /THET /, 60(/10G12, 5))
C
C IPRNT=8, COMMON COEF, MATCOM, ITERAT
      IF (IPRNT, EQ, 8) WRITE(6, 45) TCOEF, MATIN, ITMAX, CCTEST
45  FORMAT(/5X, 15HCOMMON /COEF /, 40(/10G12, 5))
      * ,/5X, 15HCOMMON /MATCOM/, 10X, 7H MATIN, 15
      * ,/5X, 15HCOMMON /ITERAT/
      * , 10X, 7H ITMAX, 15, 7H CCTEST, 612, 5)
      RETURN
      END

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      SUBROUTINE CPUTIME(T, OT, IT)
C
C ROUTINE TO COMPUTE ABSOLUTE AND RELATIVE CPUTIME DURING EXECUTION
C
C * * * * * UNITS = SECONDS * * * * *
C

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C	USAGE:	WR06	6
C	(IT=0) TIME IS INITIALIZED BY FIRST CALL AS T=0, DT=0	WR06	7
C	CALL CPUTIM(T,DT,0)	WR06	8
C		WR06	9
C	(IT=1) COMPUTE ABSOLUTE AND INCREMENT IN CPU TIME FROM INITIAL	WR06	10
C	AND LAST CALL TO *CPUTIM*.	WR06	11
C	T = TOTAL SECONDS FROM INITIAL CALL TO *CPUTIM*	WR06	12
C	AS OUTPUT, T = TIME AT CURRENT CALL	WR06	13
C	DT = INCREMENT IN TIME (SECONDS)	WR06	14
C	DT = T(CUR)-T(PREV)	WR06	15
C		WR06	16
C	BY JOSEPH MULLEN, JR	WR06	17
C		WR06	18
C	***** CDC = VERSION *****	WR06	19
C	IF (IT,LF,0) GO TO 100	WR06	20
C		WR06	21
C	COMPUTE NEW TIME AND INCREMENT	WR06	22
C	CALL SECOND(TIME)	WR06	23
C	TIME = TIME+T0	WR06	24
C	DT = TIME-TSAV	WR06	25
C	T = TIME	WR06	26
C	TSAV = TIME	WR06	27
C	RETURN	WR06	28
C		WR06	29
C	INITIALIZE CPU TIME	WR06	30
100	T = 0.0	WR06	31
	DT = 0.0	WR06	32
	TIME = 0.0	WR06	33
	TSAV = 0.0	WR06	34
	CALL SECOND(T0)	WR06	35
	RETURN	WR06	36
	END	WR06	37
C	SUBROUTINE COMCU(DA,DR,S,X,Y,M,N,NDA,NDR)	WR07	1
C		WR07	2
C	FIT A COMPOSITE CUBIC THROUGH N POINTS, I. E., A SEPARATE CUBIC	WR07	3
C	BETWEEN EACH PAIR OF ADJACENT POINTS, SUCH THAT N-1 CUBICS ARE SO	WR07	4
C	DETERMINED THAT EACH MATCHES ITS NEIGHBORS IN FUNCTION VALUE AND	WR07	5
C	IN THE FIRST AND SECOND DERIVATIVES.	WR07	6
C		WR07	7
C	COMMON/COMF/C(50),D(50),E(50),Z1(250)	WR07	8
C	DIMENSION S(N),X(N),Y(N)	WR07	9
C	K=N-1	WR07	10
C	KUF=0	WR07	11
C	TEST FOR N LESS THAN 2	WR07	12
10	IF (N=2) 10,20,60	WR07	13
	M=1	WR07	14
	RETURN	WR07	15
C	TEST FOR N EQUAL TO 2	WR07	16
20	IF (NDA,DR,1,DR,NDR,NE,1) GO TO 50	WR07	17
	S(1)=DA	WR07	18
	S(2)=DR	WR07	19
	M=0	WR07	20
	RETURN	WR07	21
50	KUF=1	WR07	22
60	M=0	WR07	23
	F(1)=0.	WR07	24
	C(1)=0.	WR07	25
	IF (NDA,GT,1) GO TO 80	WR07	26

	D(1)=1.	WR07	27
	C(1)=0.	WR07	28
	S(1)=0A	WR07	29
	GO TO 90	WR07	30
90	D(1)=4.	WR07	31
	C(1)=2.	WR07	32
	S(1)=6.*(Y(2)-Y(1))/(X(2)-X(1))-0A*(X(2)-X(1))	WR07	33
90	IF (X(2)-X(1).GT.0) GO TO 120	WR07	34
	DO 110 I=2,N	WR07	35
	U=X(I)-X(I-1)	WR07	36
	V=X(I+1)-X(I)	WR07	37
	C(I)=0	WR07	38
	D(I)=2.*(U+V)	WR07	39
	F(I)=V	WR07	40
	S(I)=4./(U+V)*(U*U*(Y(I+1)-Y(I))+V*V*(Y(I)-Y(I-1)))	WR07	41
110	CONTINUE	WR07	42
120	IF (NDH.GT.1) GO TO 140	WR07	43
	F(N)=0.	WR07	44
	D(N)=1.	WR07	45
	S(N)=0B	WR07	46
	GO TO 150	WR07	47
140	F(N)=2.	WR07	48
	D(N)=4.	WR07	49
	S(N)=6.*(Y(N)-Y(N-1))/(X(N)-X(N-1))+0B*(X(N)-X(N-1))	WR07	50
150	C(1)=C(1)/D(1)	WR07	51
	S(1)=S(1)/C(1)	WR07	52
	DO 160 I=2,N	WR07	53
	F=C(I)-C(I-1)*E(I)	WR07	54
	C(I)=C(I)/F	WR07	55
	S(I)=(S(I)-S(I-1)*E(I))/F	WR07	56
160	CONTINUE	WR07	57
	DO 170 J=1,K	WR07	58
	I=N-J	WR07	59
	S(I)=S(I)-S(I+1)*C(I)	WR07	60
170	CONTINUE	WR07	61
	RETURN	WR07	62
	END	WR07	63

	SUBROUTINE CONFIG	WR08	1
C		WR08	2
C	INPUT AND INITIALIZE CONFIGURATION DESCRIPTION	WR08	3
C		WR08	4
	COMMON /JOPTNS/ IZ1(8)	WR08	5
1	, J0, J1, J2, J3, J4, J5, J6, NNAF, NNAFIR, NFUS, NRADX(4), NFORX(4)	WR08	6
2	, NP, NPODDIR, NF, NFINDIR, NCAN, NCANDIR, J2TEST, N	WR08	7
3	, IZP(34), IPRT(5), IYZSYM	WR08	8
	COMMON /PARAM / ABODY, NALING, NTAIL, LNC, THK, XNACH, ALPHA, BETA, ALPHAC	WR08	9
1	, DWHF, REFA, REFB, REFC, REFD, REFL, REFX, REFZ	WR08	10
	COMMON BLOCK(7500)	WR08	11
C		WR08	12
C	GEOMETRY ARRAYS	WR08	13
C		WR08	14
	WING BODY V.FIN H.TAIL	WR08	15
	DIMENSION ABCD(8)	WR08	16
1	, XAF(30), XFUS(30,4), FINORG(6,2,4), CANORG(6,2,4)	WR08	17
2	, WAFORG(20,4), ZFUS(30,4), XFIN(6,10), XCAN(6,10)	WR08	18
3	, WAFORG(20,3,40), FUSAKO(30,4), FINORD(6,2,10), CANDORD(6,2,10)	WR08	19
4	, FZORD(20,30), FUSAD(30,4), FINX2(6,2,10), CANDRI(6,2,10)	WR08	20
5	, WAFOR(20,30), SFUS(30,30,8), FINX3(6,2,10), CANDRX(6,2,10)	WR08	21
6	, FUSBY(30,4), FINOR(6,10), CANDR(6,10)	WR08	22

	7 ,	FUSAZ(30,4)	FINCR(6,10)	CANCX(6,10)	*R0R	22
C					*R0R	23
C		ING	RDY		*R0R	24
		EQUIVALENCE			*R0R	25
	1	( XAF(1) ,BLOCK(1)) ,	( XFUS(1,1) ,BLOCK(1))		*R0R	26
	2	( XAFORG(1,1) ,BLOCK(31)) ,	( ZFUS(1,1) ,BLOCK(121))		*R0R	27
	3	( XAFORG(1,1,1) ,BLOCK(111)) ,	( FUSARD(1,1) ,BLOCK(241))		*R0R	28
	4	( TZORD(1,1) ,BLOCK(191)) ,	( FUSRAD(1,1) ,BLOCK(361))		*R0R	29
	5	( XAFOR(1,1) ,BLOCK(251)) ,	( SFUS(1,1,1) ,BLOCK(241))		*R0R	30
	6		( FUSRY(1,1) ,BLOCK(361))		*R0R	31
	7		( FUSAZ(1,1) ,BLOCK(481))		*R0R	32
C		V,FIN	H,TAIL		*R0R	33
		EQUIVALENCE			*R0R	34
	6	( FINORG(1,1,1) ,BLOCK(1)) ,	( CANORG(1,1,1) ,BLOCK(1))		*R0R	35
	7	( XFIN(1,1) ,BLOCK(49)) ,	( XCAN(1,1) ,BLOCK(49))		*R0R	36
	8	( FINORG(1,1,1) ,BLOCK(199)) ,	( CANORG(1,1,1) ,BLOCK(199))		*R0R	37
	9	( FINX2(1,1,1) ,BLOCK(229)) ,	( CANORI(1,1,1) ,BLOCK(229))		*R0R	38
	10	( FINX3(1,1,1) ,BLOCK(349)) ,	( CANORY(1,1,1) ,BLOCK(349))		*R0R	39
	1	( FINOR(1,1) ,BLOCK(469)) ,	( CANOR(1,1) ,BLOCK(469))		*R0R	40
	2	( FINCR(1,1) ,BLOCK(529)) ,	( CANCR(1,1) ,BLOCK(529))		*R0R	41
C					*R0R	42
		LOGICAL LPRT,HEADR,READR,READF			*R0R	43
		DATA PT/3,14159265/			*R0R	44
		REWIND 9			*R0R	45
		LPRT=IPRT(1),GT,0			*R0R	46
C					*R0R	47
C		REFERENCE AREA			*R0R	48
C					*R0R	49
		REFA=1.			*R0R	50
		IF (J0,NE,0) READ (5,480) REFA			*R0R	51
CH		WRITE (9) REFA			*R0R	52
		IF (LPRT) WRITE(6,490) REFA			*R0R	53
C					*R0R	54
C		ING -----			*R0R	55
C					*R0R	56
		IF (J1,EQ,0) GO TO 160			*R0R	57
		IF (LPRT) WRITE(6,500)			*R0R	58
		N=IAMS(XAFOR)			*R0R	59
		NREC=(N+9)/10			*R0R	60
		I1=-9			*R0R	61
		I2=0			*R0R	62
		DO 20 N=1, NREC			*R0R	63
		I1=I1+10			*R0R	64
		I2=I2+10			*R0R	65
		READ (5,480) (XAF(I),I=I1,I2)			*R0R	66
		IF (LPRT) WRITE(6,510) N,(XAF(I),I=I1,I2)			*R0R	67
20		CONTINUE			*R0R	68
C					*R0R	69
		IF (LPRT) WRITE(6,520)			*R0R	70
		DO 30 I=1, N*AF			*R0R	71
		READ (5,480) (XAFORG(I,J),J=1,4)			*R0R	72
		IF (LPRT) WRITE(6,510) I,(XAFORG(I,J),J=1,4)			*R0R	73
30		CONTINUE			*R0R	74
C					*R0R	75
C		J1 = -1 INDICATES UNCAMBERED ING DATA			*R0R	76
C					*R0R	77
		IF (J1,LT,0) GO TO 80			*R0R	78
		IF (LPRT) WRITE(6,540)			*R0R	79
		DO 50 N=1, N*AF			*R0R	80
		I1=-9			*R0R	81
		I2=0			*R0R	82
		DO 40 N=1, NREC			*R0R	83
					*R0R	84

	I1=I1+10		
	I2=I2+10		
	READ (5,480) (TZORD(NN,I),I=I1,I2)	WR08	85
	DO 40 I=I1,I2	WR08	86
	IF (WAFORG(NN,4).EQ.0.) GO TO 40	WR08	87
	TZORD(NN,I)=TZORD(NN,I)+100./WAFORG(NN,4)	WR08	88
40	CONTINUE	WR08	89
	IF (LPRT) WRITE(6,510) NN,(TZORD(NN,I),I=I1,I2)	WR08	90
50	CONTINUE	WR08	91
	GO TO 40	WR08	92
60	DO 70 I=1,N*AF	WR08	93
	DO 70 K=1,L	WR08	94
	TZORD(I,K)=0.	WR08	95
70	CONTINUE	WR08	96
80	L=1	WR08	97
C		WR08	98
C	NWAFOR POSITIVE INDICATES SYMMETRICAL ORDINATES	WR08	99
C	NEGATIVE INDICATES UPPER AND LOWER ORDINATES GIVEN	WR08	100
C		WR08	101
	IF (NWAFOR.LT.0) L=2	WR08	102
	IF (LPRT) WRITE(6,550)	WR08	103
	DO 100 NN=1,N*AF	WR08	104
	DO 100 K=1,L	WR08	105
	I1=-9	WR08	106
	I2=0	WR08	107
	DO 90 N1=1,N*REC	WR08	108
	I1=I1+10	WR08	109
	I2=I2+10	WR08	110
	READ (5,480) (WAFORD(NN,K,I),I=I1,I2)	WR08	111
	IF (LPRT) WRITE(6,510) NN,(WAFORD(NN,K,I),I=I1,I2)	WR08	112
90	CONTINUE	WR08	113
100	CONTINUE	WR08	114
	DO 110 NN=1,N*AF	WR08	115
	DO 110 K=1,L	WR08	116
	WAFORD(NN,K)=WAFORD(NN,1,K)	WR08	117
	IF (L.EQ.1) GO TO 110	WR08	118
	WAFORD(NN,K)=(WAFORD(NN,1,K)+WAFORD(NN,2,K))/2.	WR08	119
	TZORD(NN,K)=(WAFORD(NN,1,K)-WAFORD(NN,2,K))/2.+TZORD(NN,K)	WR08	120
110	CONTINUE	WR08	121
	IF (NWAFOR.LT.0) GO TO 130	WR08	122
	DO 120 NN=1,N*AF	WR08	123
	DO 120 K=1,L	WR08	124
	WAFORD(NN,2,K)=WAFORD(NN,1,K)	WR08	125
120	CONTINUE	WR08	126
130	NWAFOR=IABS(NWAFOR)	WR08	127
	NN=NWAFOR	WR08	128
	J1=IABS(J1)	WR08	129
C		WR08	130
C	CHANGE WING TO ACTUAL UNITS	WR08	131
C		WR08	132
	DO 150 I=1,NWAF	WR08	133
	F=.01*WAFORG(I,4)	WR08	134
	E3=WAFORG(I,3)	WR08	135
	DO 140 J=1,NWAFOR	WR08	136
	WAFORD(I,1,J)=E+WAFORD(I,1,J)+E3+TZORD(I,J)*F	WR08	137
	WAFORD(I,2,J)=-F+WAFORD(I,2,J)+E3+TZORD(I,J)*E	WR08	138
	WAFORD(I,3,J)=WAFORG(I,1)+L*WAF(J)	WR08	139
140	CONTINUE	WR08	140
150	CONTINUE	WR08	141
C	WRITE (9) BLOCK	WR08	142
150	CONTINUE	WR08	143
	N=IABS(NWAFOR)	WR08	144
C		WR08	145
C	FUSELAGE (BODY) -----	WR08	146
C		WR08	147

C	IF (J2.EQ.0) GO TO 290	NR08 148
	J2TEST=3	NR08 149
C		NR08 150
C	J2 < 0 AND J6 = -1 INDICATE CIRCULAR/ELLIPTIC FUSELAGE SYMMETRICAL	NR08 151
C	WITH THE XY-PLANE	NR08 152
C	J2 < 0 AND J6 = 0 INDICATE CIRCULAR/ELLIPTIC CAMBERED FUSELAGE	NR08 153
C	J6 = 1 INDICATES COMPLETE CONFIGURATION SYMMETRICAL WITH THE	NR08 154
C	XY-PLANE	NR08 155
C	J2 = -1, READ FUSELAGE CROSS SECTIONAL AREAS VS XFUS ON INPUT	NR08 156
C	J2 = -2, READ FUSELAGE RADII VS XFUS ON INPUT	NR08 157
C	J2 = -3, READ ELLIPTIC FUSELAGE SEMI-MAJOR AXES VS XFUS	NR08 158
C		NR08 159
	IF (J2.LE.-1.AND.J6.EQ.-1) J2TEST=1	NR08 160
	IF (J2.LE.-1.AND.J6.EQ.0) J2TEST=2	NR08 161
	IF (J6.EQ.1) J2TEST=1	NR08 162
	READA=J2.EQ.-1	NR08 163
	READR=J2.EQ.-2	NR08 164
	READS=J2.EQ.-3	NR08 165
	J2=1	NR08 166
C		NR08 167
C	READ XFUS	NR08 168
C	IF (LPRT) WRITE(6,570)	NR08 169
	DO 290 N1=1,NFUS	NR08 170
	NRADENRAD1(NFU)	NR08 171
	NFUSOR=NFORX(NFU)	NR08 172
	N=NFSOR	NR08 173
	NREC=(N+9)/10	NR08 174
	I1=-9	NR08 175
	I2=0	NR08 176
	DO 170 N1=1,NREC	NR08 177
	I1=I1+10	NR08 178
	I2=I2+10	NR08 179
	READ (5,600) (XFUS(I,NFU),I=I1,I2)	NR08 180
	IF (LPRT) WRITE(6,510) NFU,(XFUS(I,NFU),I=I1,I2)	NR08 181
170	CONTINUE	NR08 182
C		NR08 183
C	J2TEST = 2 INDICATES CIRCULAR/ELLIPTIC CAMBERED FUSELAGE	NR08 184
C		NR08 185
	IF (J2TEST.EQ.2) GO TO 190	NR08 186
	I1=-9	NR08 187
	I2=0	NR08 188
	IF (LPRT) WRITE(6,580)	NR08 189
	DO 180 N1=1,NREC	NR08 190
	I1=I1+10	NR08 191
	I2=I2+10	NR08 192
	READ (5,600) (ZFUS(I,NFU),I=I1,I2)	NR08 193
	IF (LPRT) WRITE(6,510) NFU,(ZFUS(I,NFU),I=I1,I2)	NR08 194
180	CONTINUE	NR08 195
	GO TO 210	NR08 196
190	DO 200 I=1,NFSOR	NR08 197
	ZFUS(I,NFU)=0.	NR08 198
200	CONTINUE	NR08 199
C		NR08 200
C	J2TEST = 3 INDICATES ARBITRARY FUSELAGE - READ YJ, + ZJ OF SECTION	NR08 201
C		NR08 202
210	IF (J2TEST.EQ.3) GO TO 250	NR08 203
	NCARO=(NCAR+9)/10	NR08 204
	DO 240 JX=1,NFSOR	NR08 205
	DO 230 K=1,2	NR08 206
	IF (LPRT.AND.K.EQ.1) WRITE(6,590)	NR08 207
	IF (LPRT.AND.K.EQ.2) WRITE(6,600)	NR08 208
	KK=K+(NFU-1)*2	NR08 209
		NR08 210



	I1=10	*R08 211
	I1=-9	*R08 212
	I2=0	*R08 213
	DO 220 NN=1,NCARD	*R08 214
	IF (NN.EQ.NCARD) I1=MOD(NRAD,10)	*R08 215
	IF (I1.EQ.0) I1=10	*R08 216
	I1=I1+10	*R08 217
	I2=I2+I1	*R08 218
	READ (5,480) (SFUS(I,JX,KK),I=1,12)	*R08 219
	IF (LPRT) WRITE(6,510) JX,(SFUS(I,JX,KK),I=1,12)	*R08 220
220	CONTINUE	*R08 221
230	CONTINUE	*R08 222
240	CONTINUE	*R08 223
	GO TO 280	*R08 224
C		*R08 225
C	CIRCULAR/ELLIPTIC FUSELAGE - READ CROSS SECTIONAL AREAS/RADII	*R08 226
C		*R08 227
250	CONTINUE	*R08 228
	IF (LPRT.AND.READA) WRITE(6,610)	*R08 229
	IF (LPRT.AND.READR) WRITE(6,615)	*R08 230
	IF (LPRT.AND.READE) WRITE(6,680)	*R08 231
	DO 255 I=1,NFUSOR	*R08 232
255	FUSAZ(I,NFU)=0.0	*R08 233
	I1=-9	*R08 234
	I2=0	*R08 235
	DO 260 NI=1,NREC	*R08 236
	I1=I1+10	*R08 237
	I2=I2+10	*R08 238
	IF (READA) READ (5,480) (FUSARD(I,NFU),I=1,12)	*R08 239
	IF (READR) READ (5,480) (FUSRAD(I,NFU),I=1,12)	*R08 240
	IF (READE) READ (5,480) (FUSBY(I,NFU),I=1,12)	*R08 241
	IF (LPRT.AND.READA) WRITE(6,510) NFU,(FUSARD(I,NFU),I=1,12)	*R08 242
	IF (LPRT.AND.READR) WRITE(6,510) NFU,(FUSRAD(I,NFU),I=1,12)	*R08 243
	IF (LPRT.AND.READE) WRITE(6,510) NFU,(FUSBY(I,NFU),I=1,12)	*R08 244
260	CONTINUE	*R08 245
C		*R08 246
	IF (.NOT.READE) GO TO 268	*R08 247
	WRITE(6,690)	*R08 248
	DO 264 I1=1,NFUSOR,10	*R08 249
	I2=I1+9	*R08 250
	READ(5,480) (FUSAZ(I,NFU),I=1,12)	*R08 251
	IF (LPRT) WRITE(6,510) NFU,(FUSAZ(I,NFU),I=1,12)	*R08 252
264	CONTINUE	*R08 253
268	CONTINUE	*R08 254
	DO 270 I=1,NFUSOR	*R08 255
	IF (READA) FUSRAD(I,NFU)=SQRT(FUSARD(I,NFU)/PI)	*R08 256
	IF (READR) FUSARD(I,NFU)=PI*FUSRAD(I,NFU)**2	*R08 257
	IF (FUSAZ(I,NFU).LE.0.) FUSAZ(I,NFU)=FUSBY(I,NFU)	*R08 258
270	CONTINUE	*R08 259
280	CONTINUE	*R08 260
CR	WRITE (9) PLOCK	*R08 261
290	CONTINUE	*R08 262
C		*R08 263
C	POD GEOMETRY JUMPY READ STATEMENTS -----	*R08 264
C		*R08 265
	IF (J3.EQ.0) GO TO 330	*R08 266
	NONPDNR	*R08 267
	NREC=(N+9)/10	*R08 268
	DO 320 NN=1,NP	*R08 269
	READ (5,470) ARCD	*R08 270
	DO 300 NI=1,NREC	*R08 271
	READ (5,470) ARCD	*R08 272
300	CONTINUE	*R08 273

	DO 310 M=1,NREC	WROB 274
	READ (5,470) AHCO	WROB 275
310	CONTINUE	WROB 276
320	CONTINUE	WROB 277
C		WROB 278
C	FINS (VERTICAL TAILS) -----	WROB 279
C		WROB 280
330	IF (J4.EQ.0) GO TO 380	WROB 281
	N=NFINDR	WROB 282
	DO 350 NN=1,NF	WROB 283
	READ (5,480) ((FINDRG(NN,I,J),J=1,4),I=1,2)	WROB 284
	IF (LPRT) WRITE(6,620) NN,((FINDRG(NN,I,J),J=1,4),I=1,2)	WROB 285
	READ (5,480) (XFIN(NN,I),I=1,N)	WROB 286
	IF (LPRT) WRITE(6,630) (XFIN(NN,I),I=1,N)	WROB 287
	READ (5,480) (FINDRD(NN,1,J),J=1,N)	WROB 288
	IF (LPRT) WRITE(6,640) (FINDRD(NN,1,J),J=1,N)	WROB 289
	DO 340 J=1,N	WROB 290
	FINDR(NN,J)=0.	WROB 291
	FINDR(NN,J)=FINDRD(NN,1,J)	WROB 292
340	CONTINUE	WROB 293
350	CONTINUE	WROB 294
C		WROB 295
C	CHANGE FINS TO ACTUAL UNITS	WROB 296
C		WROB 297
	DO 370 LQ=1,NF	WROB 298
	DO 370 J=1,2	WROB 299
	J=3-J	WROB 300
	E=.01*FINDRG(LQ,J,4)	WROB 301
	E2=FINDRG(LQ,J,2)	WROB 302
	DO 360 K=1,NFINDR	WROB 303
	EE=FINDRD(LQ,1,K)*E	WROB 304
	FINDRD(LQ,J,K)=E2+EE	WROB 305
	FINDX2(LQ,J,K)=E2+EE	WROB 306
	FINDX3(LQ,J,K)=FINDRG(LQ,J,1)+E*XFIN(LQ,K)	WROB 307
360	CONTINUE	WROB 308
370	CONTINUE	WROB 309
CR	WRITE (9) BLOCK	WROB 310
380	CONTINUE	WROB 311
C		WROB 312
C	CANARDS (HORIZONTAL TAILS) -----	WROB 313
C		WROB 314
	IF (J5.EQ.0) GO TO 460	WROB 315
	N=IARS(NCANR)	WROB 316
	DO 420 NN=1,NCAN	WROB 317
	READ (5,480) ((CANORG(NN,I,J),J=1,4),I=1,2)	WROB 318
	IF (LPRT) WRITE(6,510) NN,((CANORG(NN,I,J),J=1,4),I=1,2)	WROB 319
	READ (5,480) (XCAN(NN,I),I=1,N)	WROB 320
	IF (LPRT) WRITE(6,650) (XCAN(NN,I),I=1,N)	WROB 321
	READ (5,480) (CANORD(NN,1,J),J=1,N)	WROB 322
	IF (LPRT) WRITE(6,670) (CANORD(NN,1,J),J=1,N)	WROB 323
C		WROB 324
C	NCANR POSITIVE INDICATES SYMMETRICAL ORDINATES	WROB 325
C	NCANR NEGATIVE INDICATES UPPER AND LOWER ORDINATES ARE GIVEN	WROB 326
C		WROB 327
	IF (NCANR.LT.0) GO TO 400	WROB 328
	DO 390 J=1,N	WROB 329
	CANCR(NN,J)=0.	WROB 330
	CANCR(NN,J)=CANORD(NN,1,J)	WROB 331
	CANCR1(NN,1,J)=CANORD(NN,1,J)	WROB 332
390	CONTINUE	WROB 333
	GO TO 420	WROB 334
400	CONTINUE	WROB 335
	READ (5,480) (CANCR1(NN,1,J),J=1,N)	WROB 336

IF (LPRT) WRITE(6,670) (CANOR1(NN,1,J),J=1,N)	WROR 337
DO 410 J=1,N	WROR 338
CANOR(NN,J)=(CANORD(NN,1,J)+CANOR1(NN,1,J))/2.	WROR 339
CANCR(NN,J)=(CANORD(NN,1,J)-CANOR1(NN,1,J))/2.	WROR 340
CONTINUE	WROR 341
420 CONTINUE	WROR 342
C	WROR 343
CHANGE CANARD TO ACTUAL UNITS	WROR 344
C	WROR 345
DO 450 NN=1,NCAN	WROR 346
DO 440 K=1,2	WROR 347
I=3-K	WROR 348
E=.01*CANDRG(NN,I,4)	WROR 349
E3=CANDRG(NN,I,5)	WROR 350
DO 430 J=1,N	WROR 351
CANORD(NN,1,J)=E*CANDRD(NN,1,J)+E3	WROR 352
CANOR1(NN,1,J)=E*CANDR1(NN,1,J)+E3	WROR 353
CANDRX(NN,1,J)=CANDRG(NN,I,1)+E*XCAN(NN,J)	WROR 354
430 CONTINUE	WROR 355
440 CONTINUE	WROR 356
450 CONTINUE	WROR 357
CH WRITE (9) BLOCK	WROR 358
460 CONTINUE	WROR 359
REWIND 9	WROR 360
RETURN	WROR 361
C	WROR 362
470 FORMAT (8A10)	WROR 363
480 FORMAT (10F7.0)	WROR 364
490 FORMAT(///10X,26HVEHICLE GEOMETRY DEFINITION,74X,12H** CONFIG **	WROR 365
* ,75X,53HREFERENCE AREA (J0,GT,0) REFA=,G13.6)	WROR 366
500 FORMAT(//5X,45H XAF = WING ORDINATES FOR AIRFOIL (: CHORD)	WROR 367
* ,10H (J1,NE,0))	WROR 368
510 FORMAT(//5X,10F10.4)	WROR 369
520 FORMAT(//5X,42HWAFFRG = WING AIRFOIL LEADING EDGE + CHORD	WROR 370
* ,74X,1H1,7X,1HX,9X,1HY,9X,1HZ,5X,5HCHORD)	WROR 371
540 FORMAT(//5X,30H TZORD = WING CAMBER, Z VS XAF)	WROR 372
550 FORMAT(//5X,45HWAFFRD = WING AIRFOIL ORDINATE (+SYM,=UP/LOW)	WROR 373
* ,9H NKAFFR=,15)	WROR 374
570 FORMAT(//5H NFU,5X,26HXFUS = FUSELAGE X=STATIONS)	WROR 375
580 FORMAT(//5H NFU,5X,37HZFUS = FUSELAGE Z=CAMBER VS XFUS FOR	WROR 376
* ,16HCIRCULAR SECTION)	WROR 377
590 FORMAT(//5H JX,5X,42HY = COORDINATE ARBITRARY FUSELAGE SECTION	WROR 378
1 ,6H(SFUS))	WROR 379
600 FORMAT(//5H JX,5X,42HZ = COORDINATE ARBITRARY FUSELAGE SECTION	WROR 380
1 ,6H(SFUS))	WROR 381
610 FORMAT(//5X,45HCFUSAD = CIRCULAR FUSELAGE CROSS SECTION AREA)	WROR 382
615 FORMAT(//5X,32HCFUSRD = CIRCULAR FUSELAGE RADIUS)	WROR 383
620 FORMAT(//5X,38HFINDRG = VERTICAL FIN AIRFOIL ORIGIN#	WROR 384
* ,5X,4HFIN SEG=,15,//10X,1HX,9X,1HY,9X,1HZ,5X,5HCHORD	WROR 385
* ,5H IN ,4F10.3,5H OUT,4F10.3)	WROR 386
630 FORMAT(//5X,40H XFIN = X-STATION FIN AIRFOIL (: CHORD),//10F10.4)	WROR 387
640 FORMAT(//5X,40HFINRD = AIRFOIL ORDINATES VS XFIN (SYM),//10F10.4)	WROR 388
650 FORMAT(//5X,41HCANRG = HORIZONTAL TAIL AIRFOIL ORIGIN#	WROR 389
* ,5X,9HTAIL SEG=,13,//10X,1HX,9X,1HY,9X,1HZ,5X,5HCHORD	WROR 390
* ,5H IN ,4F10.3,5H OUT,4F10.3)	WROR 391
650 FORMAT(//5X,41H XCAN = X-STATION TAIL AIRFOIL (: CHORD),//10F10.4)	WROR 392
670 FORMAT(//5X,41HCANRD = AIRFOIL ORDINATES VS XCAN (SYM),//10F10.4)	WROR 393
680 FORMAT(//5H NFU,5X,41HFSHY = ELLIPTIC FUSELAGE SEMI-MAJOR AXES)	WROR 394
690 FORMAT(//5H NFU,5X,41HFSZ = ELLIPTIC FUSELAGE SEMI-MINOR AXES)	WROR 395
END	WROR 396

	SUBROUTINE CUBIC2(X,Y,D,C,J)	WB09	1
C		WB09	2
C	FIT A CURIC TO TWO POINTS GIVEN THE SLOPE AT EACH POINT	WB09	3
C		WB09	4
	DIMENSION X(2),Y(2),D(2),C(4)	WB09	5
	X2=X(2)	WB09	6
	H=X(1)-X2	WB09	7
	IF (H.NE.0.) GO TO 20	WB09	8
10	J=3	WB09	9
	RETURN	WB09	10
20	A=(Y(1)-Y(2))/H	WB09	11
	E=X(1)+X2	WB09	12
	C(4)=(D(1)+D(2)-A-A)/H/B	WB09	13
	C(3)=(A-D(2))/B-C(4)*(E+X2)	WB09	14
	C(2)=A-E+C(3)-C(4)*(E+X2+X(1)**2)	WB09	15
	C(1)=Y(2)-X2*(C(2)+X2*(C(3)+X2*C(4)))	WB09	16
	J=1	WB09	17
	RETURN	WB09	18
	END	WB09	19
	COMPLEX FUNCTION DBLU(Z)	WB10	1
C		WB10	2
C	THIS FUNCTION SUBROUTINE CALCULATES THE INTERMEDIATE TRANSFORM	WB10	3
C	VARIABLE W FOR THE CONFORMAL TRANSFORMATION OF AN ELLIPTICAL	WB10	4
C	BODY WITH WINGS	WB10	5
C		WB10	6
	COMMON/COM1/A2,B2,R2	WB10	7
	COMMON/COM3/ZR,ZI	WB10	8
	COMMON/COM5/D+DZ	WB10	9
	COMMON/COM6/W2,W	WB10	10
C		WB10	11
C	COMPLEX Z,Z2,D+DZ,W,W2,W	WB10	12
		WB10	13
	Z2=Z*Z	WB10	14
	ZR=REAL(Z)	WB10	15
	ZI=AIMAG(Z)	WB10	16
	IF (ZR.NE.0.0) ZR=ZR/ABS(ZR)	WB10	17
	IF (ZI.NE.0.0) ZI=ZI/ABS(ZI)	WB10	18
	Z2=Z2-A2+R2	WB10	19
	W=AIMAG(Z2)	WB10	20
	AY=1.0	WB10	21
	IF (Y.LT.0.0) AY=-1.0	WB10	22
	AYZ=1.0	WB10	23
	IF (ZI.LT.0.0) AYZ=-1.0	WB10	24
	Z2=CSQRT(Z2)*AY*AYZ	WB10	25
	IF (ABS(ZI).LE.0.0).AND.(REAL(Z).LT.0.0) Z2=CMPLX(-REAL(Z2),	WB10	26
1	AIMAG(Z2))	WB10	27
	D+DZ=0.5*(1.0+Z/Z2)	WB10	28
	W=0.5*(Z+Z2)	WB10	29
	W2=1.0/W/W	WB10	30
	DBLU=W	WB10	31
	RETURN	WB10	32
	END	WB10	33

	SUBROUTINE DERIV(X,Y,N,NDA,DA,FD)	WB11	1
C		WB11	2
C	FIT A CHAIN OF CUBIC CURVES THROUGH A SET OF N POINTS HAVING	WB11	3
C	CONTINUOUS FIRST AND SECOND DERIVATIVES AT THE INTERMEDIATE POINTS	WB11	4
C	AND SPECIFIED FIRST OR SECOND DERIVATIVE AT THE END POINTS	WB11	5
C		WB11	6
	COMMON/CHFF/C(4,50),Z1(200)	WB11	7
	DIMENSION X(1),Y(1),FD(1)	WB11	8
	CALL SCAMP4(X,Y,N,NDA,-1,DA,0.,C,FD,0)	WB11	9
	RETURN	WB11	10
	END	WB11	11

	FUNCTION DERIV1(X1,Y1,N)	WB12	1
C		WB12	2
C	FIND THE FIRST DERIVATIVE OF THE QUADRATIC THROUGH THREE GIVEN	WB12	3
C	POINTS AT A SPECIFIED ONE OF THESE POINTS. THIS PROVIDES A GOOD	WB12	4
C	APPROXIMATION TO THE SLOPE OF A FUNCTION AT A POINT, PARTICULARLY	WB12	5
C	IF THE OTHER TWO POINTS USED ARE NEARBY.	WB12	6
C		WB12	7
	DIMENSION X(3),Y(3),X1(3),Y1(3)	WB12	8
	EQUIVALENCE (S,K)	WB12	9
	DO 10 J=1,3	WB12	10
	X(J)=X1(J)	WB12	11
	Y(J)=Y1(J)	WB12	12
10	CONTINUE	WB12	13
	K=N	WB12	14
	E=Y(1)-Y(2)	WB12	15
	H=Y(1)-Y(3)	WB12	16
	A=X(1)-X(2)	WB12	17
	B=X(1)-X(3)	WB12	18
	C=A*(X(1)+X(2))	WB12	19
	DT=B*(X(1)+X(3))	WB12	20
	C3=(H+E-A*H)/(H-C-A*DT)	WB12	21
	C2=(E-C3*C)/A	WB12	22
	K1=IABS(K)	WB12	23
	DO 20 I=1,3	WB12	24
	IF (K1,FD,I) GO TO 30	WB12	25
20	CONTINUE	WB12	26
	GO TO 40	WB12	27
30	S=X(K1)	WB12	28
40	DERIV1=C2+2.*C3*S	WB12	29
	RETURN	WB12	30
	END	WB12	31

	FUNCTION DERIV2(X,Y,XX)	WB13	1
C		WB13	2
C	FIND THE SECOND DERIVATIVE OF THE CUBIC THROUGH FOUR GIVEN POINTS	WB13	3
C	AT AN ARBITRARY POINT WHOSE X COORDINATE IS SPECIFIED	WB13	4
C		WB13	5
	DIMENSION X(4),Y(4)	WB13	6
	DERIV2=0.	WB13	7
	IF (X(4),EQ,X(1)) RETURN	WB13	8
	IF (X(4),FD,X(2)) RETURN	WB13	9
	IF (X(4),EQ,X(1)) RETURN	WB13	10
	IF (X(3),EQ,X(2)) RETURN	WB13	11

IF (X(3).EQ.X(1)) RETURN	NR13	12
IF (X(2).EQ.X(1)) RETURN	NR13	13
Q41=(Y(4)-Y(1))/(X(4)-X(1))	NR13	14
Q31=(Y(3)-Y(1))/(X(3)-X(1))	NR13	15
Q21=(Y(2)-Y(1))/(X(2)-X(1))	NR13	16
F=(Q31-Q21)/(X(3)-X(2))	NR13	17
D=((Q41-Q21)/(X(4)-X(2))-F)/(X(4)-X(3))	NR13	18
C=E-D*(X(3)+X(2)+X(1))	NR13	19
DERIV2=2.*(C+3.*D*XX)	NR13	20
RETURN	NR13	21
END	NR13	22

C SUBROUTINE DIAGIN	NR14	1
C INVERT THE DIAGONAL BLOCKS OF THE MATRIX	NR14	2
C FOR MATRIX PARTITIONS X 60X60 INVERTED DIAGONALS ARE ON TAPE10.	NR14	3
C	NR14	4
COMMON /PARAM / NRBODY,NRING,NTAIL,LPC,THK,XNACH,ALPHA,BETA,ALPHAC	NR14	5
1 ,PHIR,REFA,REFB,REFC,REFD,REFE,REFX,REF7	NR14	7
COMMON /VELCOM/ NPOINT,NPART,IMAX,JMAX,NMAX,EM,IPRINT,NTHK	NR14	8
1 ,NMBLOCK,NBROW(20),NBBLOCK,NBROW(60)	NR14	9
COMMON /POINT / O(60,40),Z(2400)	NR14	10
C	NR14	11
CALL CPRTIM(TIME,DT,1)	NR14	12
REWIND 9	NR14	13
REWIND 10	NR14	14
NDIM=60	NR14	15
IF (NRBODY.EQ.0) GO TO 50	NR14	16
C READ MATRICES AND INVERT DIAGONAL BLOCKS	NR14	17
C	NR14	18
DO 40 NH=1,NBBLOCK	NR14	19
NROW=NBBROW(NH)	NR14	20
NCOL=NROW	NR14	21
IF (NRBODY.GT.NMAX) GO TO 20	NR14	22
C IF (NRBODY)61, USE ENTIRE MATRIX ON TAPE9	NR14	23
DO 10 J=1,NBODY	NR14	24
READ (9) (O(I,J),J=1,NBODY)	NR14	25
10 CONTINUE	NR14	26
GO TO 30	NR14	27
C IF (NRBODY)60, USE DIAGONAL BLOCKS ON TAPE7	NR14	28
20 READ (7) D	NR14	29
30 CALL INVERT(D,NCOL,NDIM)	NR14	30
WRITE (10) D	NR14	31
40 CONTINUE	NR14	32
C	NR14	33
C READ WING MATRICES AND INVERT DIAGONAL BLOCKS -----	NR14	34
C	NR14	35
50 CONTINUE	NR14	36
C4 IF (NRING.EQ.0) GO TO 140	NR14	37
C IF (NRING)61, READ PAST WING/HUDY MATRICES AND USE ENTIRE MATRIX	NR14	38
C130 CONTINUE	NR14	39
140 REWIND 10	NR14	40
REWIND 9	NR14	41
REWIND 7	NR14	42
CALL CPRTIM(TIME,DT,1)	NR14	43
WRITE(6,150) TIME,DT	NR14	44
150 FORMAT(//10X,14HEND DIAGIN, TIME=F10.4,5X,3HDT=F10.4)	NR14	45
RETURN	NR14	46
END	NR14	47
	NR14	48

COMPLEX FUNCTION DSDZ(S)	WB15	1
COMMON/COM2/SIG2,H2	WB15	2
COMMON/COM5/DNDZ	WB15	3
COMMON/COM4/G2,G1	WB15	4
COMMON/COM6/W2,W	WB15	5
COMPLEX W,W2,DNDZ,G1,G2	WB15	6
DSDZ=0.5*(1.0-SIG2*W2)*(1.0+G1/G2)*DNDZ	WB15	7
RETURN	WB15	8
END	WB15	9

COMPLEX FUNCTION DZDS(S)	WB16	1
COMMON/COM1/A2,H2,R2	WB16	2
COMMON/COM2/SIG2,H2	WB16	3
COMMON/COM5/W2,W	WB16	4
COMPLEX W,S,A2,G1,S2,Z,Z2	WB16	5
S2=S*S	WB16	6
G1=0.5*(1.0-0.25*(A2-H2)*W2)*(1.0-R2/S2)	WB16	7
Z=S+H2/S	WB16	8
Z2=Z+Z-4.0*SIG2	WB16	9
Y=AIMAG(Z)	WB16	10
YZ=4*IMAG(Z2)	WB16	11
AY=1.0	WB16	12
AYZ=1.0	WB16	13
IF(Y.LT.0.0) AY=1.0	WB16	14
IF(YZ.LT.0.0) AYZ=1.0	WB16	15
Z2=CSQRT(Z2)*AY*AYZ	WB16	16
IF((ABS(Y).LE.0.0).AND.(REAL(Z).LT.0.0)) Z2=CMPLX(-REAL(Z2),	WB16	17
1 AIMAG(Z2))	WB16	18
DZDS=G1*(1.0+Z/Z2)	WB16	19
RETURN	WB16	20
END	WB16	21

SUBROUTINE ELHDVT (VA,WA,XPT,YPT,ZPT,NBODY)	WB17	1
C	WB17	2
C ROUTINE ELHDVT = ELLIPTICAL BODY NOSE SEPARATION VORTEX CALCULATION	WB17	3
C	WB17	4
C THIS ROUTINE INTERPOLATES IN TABLES OF VORTEX STRENGTH AND LOCATION	WB17	5
C VERSUS X-STATION TO COMPUTE THE VORTEX VELOCITIES AT BODY CONTROL	WB17	6
C POINTS	WB17	7
C	WB17	8
DIMENSION VA(1),WA(1),XPT(1),YPT(1),ZPT(1)	WB17	9
DIMENSION G(10),VX(10),VY(10)	WB17	10
DIMENSION YVVTX(10,10),ZVVTX(10,10),GX(10,10)	WB17	11
COMMON /BVVTX / NVTX,NXVTX,AV(10),AV(10),HV(10)	WB17	12
COMMON /JVPRTS/ IZ1(64),IPRT(5),IXZSYM	WB17	13
LOGICAL LPRT,LPRT3	WB17	14
IF (NVTX.LE.0) RETURN	WB17	15
IF (NXVTX.LE.0) RETURN	WB17	16
LPRT = IPRT(1).GT.0	WB17	17
LPRT3 = IPRT(3).GT.0	WB17	18
C	WB17	19
C ----- VORTEX LOCATION AND STRENGTHS -----	WB17	20
C FIRST SUBSCRIPT = VORTEX NO. SECOND SUBSCRIPT = X-STATION	WB17	21
C	WB17	22
C READ VORTEX (Y,Z) LOCATIONS AT EACH STATION BY VORTEX	WB17	23
C	WB17	24

IF (LPRT) WRITE(6,190)	NR17 25
DO 130 I=1,NVIX	NR17 26
READ(5,180) (YVRTX(I,J),J=1,NXVTX)	NR17 27
IF (LPRT) WRITE(6,220) I,(YVRTX(I,J),J=1,NXVTX)	NR17 28
READ(5,180) (ZVRTX(I,J),J=1,NXVTX)	NR17 29
IF (LPRT) WRITE(6,230) I,(ZVRTX(I,J),J=1,NXVTX)	NR17 30
READ(5,180) (GX(I,J),J=1,NXVTX)	NR17 31
IF (LPRT) WRITE(6,210) I,(GX(I,J),J=1,NXVTX)	NR17 32
130 CONTINUE	NR17 33
C	NR17 34
C VORTEX INTERPOLATION SUMMARY TABLE	NR17 35
C	NR17 36
WRITE(6,230)	NR17 37
DO 135 I=1,NVIX	NR17 38
WRITE(6,240) I	NR17 39
WRITE(6,250) (J,XV(J),YVRTX(I,J),ZVRTX(I,J),AV(J),BV(J),GX(I,J),	NR17 40
* ,J=1,NXVTX)	NR17 41
135 CONTINUE	NR17 42
C	NR17 43
C ----- LOOP ON BODY CONTROL POINTS -----	NR17 44
C	NR17 45
IF (LPRT3) WRITE(6,270)	NR17 46
DO 170 I=1,NBODY	NR17 47
VA(I) = 0.0	NR17 48
VB(I) = 0.0	NR17 49
IF (XPT(I),LT,XV(1)) GO TO 170	NR17 50
IF (XPT(I),GT,XV(NXVTX)) GO TO 170	NR17 51
C	NR17 52
C LOCATE X-CONTROL POINTS IN VORTEX TABLE	NR17 53
C	NR17 54
DO 140 J=2,NXVTX	NR17 55
IF (XPT(I),LE,XV(J)) GO TO 150	NR17 56
140 CONTINUE	NR17 57
J = NXVTX	NR17 58
150 JM1 = J-1	NR17 59
SLOPE = XV(J)-XV(JM1)	NR17 60
IF (SLOPE,NE,0.) SLOPE=(XPT(I)-XV(JM1))/SLOPE	NR17 61
C	NR17 62
C INTERPOLATE FOR STRENGTH AND LOCATION OF EACH VORTEX	NR17 63
C	NR17 64
DO 160 K=1,NVIX	NR17 65
G(K) = GX(K,JM1)+(GX(K,J)-GX(K,JM1))*SLOPE	NR17 66
VX(K) = YVRTX(K,JM1)+(YVRTX(K,J)-YVRTX(K,JM1))*SLOPE	NR17 67
VY(K) = ZVRTX(K,JM1)+(ZVRTX(K,J)-ZVRTX(K,JM1))*SLOPE	NR17 68
160 CONTINUE	NR17 69
C	NR17 70
C RH IS HORIZONTAL AXIS AND BL IS VERTICAL AXIS	NR17 71
C	NR17 72
BL = AV(JM1)+(AV(J)-AV(JM1))*SLOPE	NR17 73
RH = BV(JM1)+(BV(J)-BV(JM1))*SLOPE	NR17 74
C	NR17 75
C	NR17 76
C DETERMINE Y AND Z COORDINATES OF POINT ON THE BODY SURFACE,	NR17 77
C LYING ON THE SAME RADIUS AS POINT XPT,YPT,ZPT, THAT IS WITH THE	NR17 78
C SAME POLAR ANGLE.	NR17 79
C	NR17 80
THPT=ATAN2(ZPT(1),YPT(1))	NR17 81
SINE=SIN(THPT)	NR17 82
COSINE=COS(THPT)	NR17 83
RAD=1.0/SQRT((COSINE/RH)**2+(SINE/BL)**2)	NR17 84
C	NR17 85
C MOVE POINT OUT 1 PERCENT OF BODY RADIUS.	NR17 86
C	NR17 87
RAD=1.01*RAD	NR17 88



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      VSURF=RAD*COSINE
      ZSURF=RAD*SINE
C
C COMPUTE VELOCITY COMPONENTS INDUCED BY THE SPECIFIED VORTICITY
C AT THE POINTS CALCULATED ABOVE.
C
      CALL VVELS(NVTX,VSURF,ZSURF,VX,VY,G,RR,HL,VA(I),WA(I),0.35)
C
      IF (LPRT3) WRITE(6,260) I,XPT(I),VSURF,ZSURF,VA(I),WA(I),RR,HL
      IF (LPRT3) WRITE(6,265) (K,VX(K),VY(K),G(K),K=1,NVTX)
170 CONTINUE
      RETURN
180 FORMAT(10F7.3)
190 FORMAT(///,10X,26HVORTEX LOCATION AND STRENGTH,
* 72X,12H** ELBOVT ** )
200 FORMAT(/,5H I=,13,7H ZVRTX=,10F10.4)
210 FORMAT(/,5H I=,13,7H GX=,10F10.4)
220 FORMAT(/,5H I=,13,7H YVRTX=,10F10.4)
230 FORMAT(///10X,26HVORTEX INTERPOLATION TABLE)
240 FORMAT(/ 5X,6HVORTEX,15,
* //5H STAT,7X,2HXV,5X,5HYVRTX,5X,5HZVRTX,8X,2HBY,8X,2HAZ
* ,5X,5HGAM/V/)
250 FORMAT(15,F10.3,5F10.4)
260 FORMAT(6H I=,15,7H XPT=,F10.4,7H VSURF=,F10.4,7H ZSURF=,F10.4,
* ,7H VA=,F10.5,7H WA=,F10.5,7H RR=,F10.4,7H HL=,F10.4)
265 FORMAT(6H K=,15,7H VX=,F10.4,7H VY=,F10.4,
* 7H G=,F10.4)
270 FORMAT(1H1,10X,43HVORTEX STRENGTHS AND VELOCITIES AFTER VVELS /)
      END

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      SUBROUTINE FORMOM(NPAN,NPASS,ALFA,COMPT,TSTXCP)
C
C CALCULATE THE FORCE AND MOMENT COEFFICIENTS ON THE BODY, WING,
C FIN (VERTICAL TAIL) AND CANARD (HORIZONTAL TAIL)
C NOTE: AS USED IN PROGRAM WOYBOY, BODY ONLY IS TREATED.
C
      COMMON /JPTNS/ IZ1(59),IVLIN
* ,NCPNT,XSTRT,XLEN,NCPPT,IPLOT(4),IPRT(5),IXZSYN
      COMMON /HEAD / TITLE1(8),TITLE2(8)
      COMMON /DCN/ DCN(600),DCM(600),DCT(600),Z5(600),SIND(600),
1 CDSO(600),CP(600),DUD(500),SINT(600),COST(600),GH(600),
2 GH(600),GZTOX(600)
      COMMON /FORM / CNA,CTW,CMA,CMB,CTB,CMB,CNS(20),CTS(20),CMS(20)
      COMMON /PARAM / NBDY,NWING,NTAIL,LHC,THK,XHACH,ALPHA,BETA,ALPHAC
1 ,PHIR,REFR,REFH,REFC,REFD,REFL,REFX,REFZ
      COMMON /VELCOM/ NPOINT,NPART,IMAX,JMAX,NMAX,EM,IPHINT,NWTHK
1 ,NABLOK,NARON(20),NBLBK,NARON(60)
      COMMON /AEACOM/ KJ,KWAF,KWAFQ,KRADX(4),KFORX(4),KFUS,MAX,K4,K5
1 ,KF(6),KAN(6),KFINDR(6),KANOR(6),KOL,NCPPT,LOCPT(20),XCPT(20)
      COMMON /SEG / NSEG,NROD(20),NCOL(20),COS8(20),SINS(20)
1 ,BTE(20),WAT(20),SPIN(20),ALEW(20),BLE(20),ZLEW(20),NPLT(60)
      COMMON /POINT / ARRAY(6000)
C
      DIMENSION XPT(600),YPT(600),ZPT(600),THET(600),DELTA(600),SGN(600)
1 ,AREA(600),POLAR(600),CHD(20),XLE(600), XC(50,20)
C
      EQUIVALENCE (CHD(1),DUD(1))

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1	,(XPT(1),ARRAY(1)),	(VPT(1),ARRAY(601))	WR18	28
2	,(ZPT(1),ARRAY(1201)),	(THET(1),ARRAY(1801))	WR18	29
3	,(DELTA(1),ARRAY(2401)),	(XC(1,1),ARRAY(3001))	WR18	30
4	,(SGV(1),ARRAY(3601)),	(AREA(1),ARRAY(4801))	WR18	31
5	,(XLE(1),ARRAY(5401)),	(PILAR(1),OZTOX(1))	WR18	32
	INTEGER COMPT		WR18	33
	LOGICAL LHC,LPLT,TSTXCP		WR18	34
	DATA RADDEG/G,0.174532926/		WR18	35
C			WR18	36
C	NOTE THAT THE WING, CANARD, AND TAIL ARE ALL SEGMENTS OF THE WING		WR18	37
C	IN THIS SUBROUTINE		WR18	38
C			WR18	39
C	COMPT=1 INDICATES BODY FORCE AND MOMENT CALCULATION		WR18	40
C	=2 INDICATES WING FORCE AND MOMENT CALCULATION		WR18	41
C			WR18	42
C	NPASS=1 FOR THE BODY		WR18	43
C	=1 FOR THE WING UPPER AND LOWER SURFACES IF THE NON-PLANAR		WR18	44
C	BOUNDARY CONDITION OPTION IS SELECTED		WR18	45
C	=1 FOR THE WING UPPER SURFACE IF THE PLANAR BOUNDARY		WR18	46
C	CONDITION OPTION IS SELECTED		WR18	47
C	=2 FOR THE WING LOWER SURFACE IF THE PLANAR BOUNDARY		WR18	48
C	CONDITION OPTION IS SELECTED		WR18	49
C			WR18	50
C	TSTXCP=FALSE, COMPUTE FORCES FOR ALL PANELS		WR18	51
C	=TRUE, COMPUTE FORCE ONLY BETWEEN XSTART AND XWLE		WR18	52
C			WR18	53
C	IF (TSTXCP .AND. XSTART.GE.XWLE)	RETURN	WR18	54
C	NPAN=NPAN		WR18	55
C	IF (COMPT.EQ.1) XON=XC(1,1)		WR18	56
C	CAN=0.		WR18	57
C	CTR=0.		WR18	58
C	CMT=0.		WR18	59
C			WR18	60
C	ALFA IS ALPHA SUB C IN RADS.		WR18	61
C			WR18	62
C	SIAL=STX(ALFA)		WR18	63
C	COAL=COS(ALFA)		WR18	64
C	WRITE (6,320) TITLE1,TITLE2		WR18	65
C	WRITE (6,310)		WR18	66
C	IF (.NOT.TSTXCP) WRITE (6,450)		WR18	67
C	IF (TSTXCP) WRITE(6,460) XSTART,XWLE		WR18	68
C	WRITE (6,330) XMACH,ALPHAC,RNIR		WR18	69
C	WRITE (6,350)		WR18	70
C	DO 50 I=1,NPAN		WR18	71
C	SGN(I)=1.		WR18	72
C	SIND(I)=SIN(DELTA(I))		WR18	73
C	COSD(I)=COS(DELTA(I))		WR18	74
C	SINT(I)=SIN(THET(I))		WR18	75
C	COST(I)=COS(THET(I))		WR18	76
50	CONTINUE		WR18	77
C	CN=0.		WR18	78
C	CT=0.		WR18	79
C	CM=0.		WR18	80
C	CYN=0.		WR18	81
C	CLROLL=0.		WR18	82
C	CYAW=0.		WR18	83
C	IF=0		WR18	84
C			WR18	85
C	CALCULATE THE FORCES AND MOMENT ACTING ON EACH PANEL AND SUM OVER		WR18	86
C	THE ENTIRE COMPONENT		WR18	87
C			WR18	88
C	DO 160 I=1,NPAN		WR18	89
C	IP=IP+1		WR18	90

XP=XP(I)	WB18 91
YP=YP(I)	WB18 92
ZP=ZP(I)	WB18 93
C	WB18 94
C CHECK WHETHER TO COMPUTE FORCE BETWEEN XSTART AND X*LE ONLY.	WB18 95
C	WB18 96
IF (.NOT.TSTXCP) GO TO 150	WB18 97
DCN(I) = 0.	WB18 98
DCT(I) = 0.	WB18 99
DCM(I) = 0.	WB18 100
IF (XP.LT.XSTART .OR. XP.GT.X*LE) GO TO 160	WB18 101
150 CONTINUE	WB18 102
CNORM=-CP(I)*AREA(I)*SGN(I)	WB18 103
C	WB18 104
C FORCE AND MOMENT SIGN CONVENTIONS, BODY COORDINATE SYSTEM.	WB18 105
C CNORM = POSITIVE OUTWARD NORMAL FORCE ON PANEL	WB18 106
C CXH = POSITIVE AFT	WB18 107
C CYH = POSITIVE TO RIGHT	WB18 108
C CZH = POSITIVE UP	WB18 109
C CMH = POSITIVE NOSE UP	WB18 110
C CNYAW = POSITIVE NOSE RIGHT VIEWING FORWARDS	WB18 111
C CLROLL = POSITIVE CLOCKWISE VIEWING FORWARDS	WB18 112
C	WB18 113
DCXB = -CNORM*SIN(I)	WB18 114
DCYB = -CNORM*COS(I)*SIN(I)	WB18 115
DCZB = CNORM*COS(I)*COS(I)	WB18 116
DCMB = -DCZH*(XP-REFX)+DCXB*(ZP-REFZ)	WB18 117
DCNYA = -DCYB*(XP-REFX)+DCXB*YP	WB18 118
DCLROL = -DCZB*YP +DCYB*(ZP-REFZ)	WB18 119
DCN(I) = DCZB	WB18 120
DCT(I) = DCXB	WB18 121
DCM(I) = DCMB	WB18 122
XQ=XP	WB18 123
YQ=YP	WB18 124
ZQ=ZP	WB18 125
C	WB18 126
C NONDIMENSIONALIZE BODY PANEL CONTROL POINT COORDINATES	WB18 127
C X COORDINATES ARE DIVIDED BY THE BODY REFERENCE LENGTH	WB18 128
C Y AND Z COORDINATES ARE DIVIDED BY THE BODY REFERENCE DIAMETER	WB18 129
C	WB18 130
XQ=(XP-XON)/REFL	WB18 131
YQ=YP/REFD	WB18 132
ZQ=ZP/REFD	WB18 133
THETP=ATAN2(ZP,YP)*57.29578	WB18 134
IF (THETP.LT.0.0) THETP=THETP+360.0	WB18 135
WRITE (6,360) IP,XP,YP,ZP,THETP,CP(I),DCXB,DCYB,DCZB,DCMB	WB18 136
* ,DCNYAW,DCLROL	WB18 137
CN=CN+DCN(I)	WB18 138
CT=DCT+DCT(I)	WB18 139
CM=CM+DCM(I)	WB18 140
CYH = CYH+DCYB	WB18 141
CNYAW = CNYAW+DCNYAW	WB18 142
CLROLL = CLROLL+DCLROL	WB18 143
160 POLAR(I)=ATAN2(YP,-ZP)*57.29	WB18 144
C	WB18 145
C PLOT CP VERSUS X AND POLAR ANGLE AROUND BODY	WB18 146
C	WB18 147
IF (TSTXCP) GO TO 168	WB18 148
LPLT=IPLOT(2).GT.0	WB18 149
IF (.NOT.LPLT) GO TO 168	WB18 150
NCRH=KFORX(I)-1	WB18 151
NCP =KFAOX(I)-1	WB18 152
IF (KFAUS.GT.1) NCP=NCPANL	WB18 153

IF (KFUS.GT.1) NCUR=1	154	154
DO 164 I=1, NCUR		155
164 NPLT(I)=NDP		156
CALL PLOT2(XPT,CP,2,NPLT,NDP,NCUR,100,50)		157
WRITE(6,500)		158
CALL PLOT2(POLAR,CP,2,NPLT,NDP,NCUR,100,50)		159
WRITE(6,510)		160
164 CONTINUE		161
C		162
C STORE BODY AND WING FORCES AND MOMENT		163
C		164
CM=CM		165
CT=CT		166
CM=CM		167
WRITE (6,470)		168
IF (.NOT.TSTXCP) WRITE (6,450)		169
IF ( TSTXCP) WRITE(6,460) XSTART,XALE		170
C		171
C COMPUTE NORMAL AND TANGENTIAL (AXIAL) FORCE, PITCHING MOMENT,		172
C LIFT AND DRAG COEFFICIENTS, AND COMPONENT CENTER OF PRESSURE		173
C		174
C CHECK FOR SYMMETRIC CONFIGURATION		175
SYN = 2.0		176
IF (IXZSYN.EQ.0) SYN=1.0		177
CN=SYN*CN/REFA		178
CT=SYN*CT/REFA		179
CM=SYN*CM/(REFA*REFD)		180
CYH=CYH/REFA		181
CYAA=(CYAA/(REFA*REFD)		182
CLROLL=CLROLL/(REFA*REFD)		183
C		184
C		185
IF (IXZSYN.EQ.0) CYH=0.		186
IF (IXZSYN.EQ.0) CLROLL=0.		187
IF (IXZSYN.EQ.0) CYAA=0.		188
C		189
C TRANSFORM FORCES AND MOMENTS (EXCEPT ROLLING MOMENT) INTO		190
C X-Y-Z AXIS SYSTEM.		191
C		192
PHI=PHI+RADDEG		193
SINPHI=SIN(PHI)		194
COSPHI=COS(PHI)		195
C		196
CL=CN*COSPHI+COAL-CYH*SINPHI*COAL-CT*SIAL		197
CY=CN*SINPHI+CYH*COSPHI		198
CO=CT*COAL-CYH*SIAL+SINPHI+CN*SIAL+COSPHI		199
C		200
CYAA=COSPHI-CYAA*SINPHI		201
CYAA=COSPHI+CYAA*SINPHI+CYAA*COAL+COSPHI-CLROLL*SIAL		202
C		203
C		204
C OXN IS CENTER OF PRESSURE LOCATION MEASURED FROM NOSE TIP		205
C		206
OXN=0.		207
IF (CM.EQ.0.) OXN=(-CM/CN)*REFD+REFX		208
IF (COMPT.EQ.1) WRITE (6,490) REFA,REFD,REFL		209
WRITE (6,490) REFX,REFZ		210
WRITE (6,510) XNACH,ALPHACH,ALPHA,PHI,REFA,CT,CYH,CN,CM,CYAA		211
* ,CLROLL,OXN,CL,CY,CO,CN,CYAA		212
RETURN		213
310 FORMAT (//10X,40I10/10X,2A10)		214
* ,10X,12H** FORM** /)		215
320 FORMAT (1+1,9X,4A10/10X,2A10)		216

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330  FORMAT (/10X,6MMACH =,F8.4,3X,7HALPHAC=F8.4,4X,5SHPHIR=F8.4/)  W818 217
350  FORMAT (3X,5HPOINT,7X,1HX,10X,1HX,10X,1HZ,6X,5HWFPT,4X,2HCP,9X,  W818 218
    * 2HCX,4X,2HCY,4X,2HCZ,4X,2HCM,8X,3HCLN,8X,3HCLL/)  W818 219
360  FORMAT (17,11F11.5)  W818 220
370  FORMAT (141,9X,18MTOTAL COEFFICIENTS/10X,18(1H=))  W818 221
390  FORMAT (10X,5HREFA=F14.4,3X,5HREFD=F14.4,3X,5HREFL=F14.4)  W818 222
400  FORMAT (/10X,5HXM =,F14.4,3X,5HZM =,F14.4)  W818 223
410  FORMAT (/8X,5HMACH=F15.5,6X,7HALPHAC=F15.5,7X,6HALPHA=F15.5,  W818 224
    * /8X,5SHPHIR=F15.5,4X,5HBETA=F15.5,10X,3HCY=F15.5  W818 225
    * /10X,3HCY=F15.5,10X,3HCZ=F15.5,10X,3HCM=F15.5  W818 226
    * /9X,4HCLN=F15.5,9X,4HCLL=F15.5,9X,4HXCPC=F15.5,  W818 227
    * //10X,33MFOLLOWING ARE IN WIND AXIS SYSTEM,  W818 228
    * /10X,3HCL=F15.5,10X,3HCY=F15.5,  W818 229
    * /10X,3HCD=F15.5,9X,4HCMW=F15.5,  W818 230
    * /6X,7HCYAWW=F15.5,/)  W818 231
450  FORMAT (10X,11MON THE BODY//)  W818 232
460  FORMAT(10X,24MON THE BODY FROM XSTART=F10.4,9H TO XWLE=F10.4//)  W818 233
500  FORMAT(/20X,11HCP VERSUS X)  W818 234
510  FORMAT(/20X,24HCP VERSUS MERIDIAN ANGLE)  W818 235
    END  W818 236

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SUBROUTINE GEOM  W819 1
CDC  OVERLAY (L=0,1,0)  W819 2
CDC  PROGRAM GEOM  W819 3
C  W819 4
C  INPUT CONFIGURATION GEOMETRY AND COMPUTE PANELS  W819 5
C  W819 6
C  SPECIAL COMMENT CARDS STARTING WITH:  W819 7
C  CH = ELIMINATED FOR BODY PROGRAM VERSION ONLY  W819 8
C  CNP = ELIMINATED FOR NON PLANAR PANEL ONLY  W819 9
C  W819 10
C  TAPE USAGE IN GEOM=  W819 11
C  TAPE5:  GEOM,  READ INPUT  W819 12
C  W819 13
C  TAPE7:  GEOM,  REWIND  W819 14
C  BODYPAN,  WRITE  ARRAY  - SAVE BODY GEOMETRY  W819 15
C  W819 16
C  TAPE8:  NOT USED IN BODY VERSION  W819 17
C  TAPE9:  NOT USED IN BODY VERSION  W819 18
C  W819 19
C  TAPE10:  GEOM,  REWIND  W819 20
C  NEWRAD,  WRITE XB,YB,ZB = FROM ARRAY  W819 21
C  BODYPAN,  REWIND  W819 22
C  W819 23
C  READ XB,YB,ZB = INTO BLOCK  W819 24
C  REWIND  W819 25
C  W819 26
COMMON /JOPTNS/ IZ1(8)  W819 27
1  ,J0,J1,J2,J3,J4,J5,J6,NWAF,NWAFOR,NFUS,NRADX(4),NFORX(4)  W819 28
2  ,NP,NPDDIR,NF,NFINOR,NCAN,NCANOR,J2TEST,NW, IZ2(25)  W819 29
3  ,NVLIN,NCPDIT,XSTART,XWLE,NXCPT,IPLT(4),IPRT(5),IXZSYN  W819 30
COMMON /PARAM / KBODY,NWING,NTAIL,LBC,THK,XMACH,ALPHA,BETA,ALPHAC  W819 31
1  ,PHIR,REFA,REFB,REFC,REFD,REFL,REFX,REFZ  W819 32
COMMON /HEAD / TITLE1(8),TITLE2(8)  W819 33
COMMON /SEG / NSEG,NROW(20),NCOL(20),CNSS(20),SINS(20)  W819 34
1  ,RTE(20),NWT(20),SPNW(20),XLE=(20),BLE(20),ZLE=(20),ZB(60)  W819 35
COMMON  BLOCK(7500)  W819 36
COMMON /NEWCOM/ K1,KWAF,KWAFOR,KWADIR(4),KFORX(4),KFUS,MAX,K4,K5  W819 37
1  ,KF(6),KX(6),KFINDIR(6),KAMOR(6),KFL,NCPD,LOCPT(20),XCPT(20)  W819 38
COMMON /VELCOM/ NPOINT,NPART,IZ4(2),NMAX,EM,IPRINT,NWTHK  W819 39

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1	,N=NBLOCK,NBROW(20),N=NBLOCK,NBROW(60)	WB19	39
	COMMON/ITERAT/ITMAX,CCTEST	WB19	40
	COMMON /RVMTX / NVTX,NVVTX,XV(10),AV(10),BV(10)	WB19	41
C		WB19	42
	LOGICAL LBC,THK,FAIL,LPRT	WB19	43
C		WB19	44
	IF (INIT.EQ.1) GO TO 9	WB19	45
	DO 5 I=1,24	WB19	46
5	KF(I)=0	WB19	47
	DO 6 I=1,260	WB19	48
6	NROW(I)=0	WB19	49
9	INIT=1	WB19	50
C		WB19	51
	LBC=,TRUE,, FOR PLANAR BOUNDARY CONDITION ON WINGS (LINBC=1)	WB19	52
C	LBC=,FALSE,, FOR NON-PLANAR BOUNDARY CONDITION (LINBC=0)	WB19	53
C	THK = ,TRUE,, FOR WINGS WITH THICKNESS AND NONPLANAR PANELING	WB19	54
C	(ITHICKX0)	WB19	55
CNP	LBC=,FALSE.	WB19	56
	LBC=,TRUE.	WB19	57
	THK=,FALSE.	WB19	58
	EM=0.	WB19	59
	ALPHA = 0.0	WB19	60
	BETA = 0.0	WB19	61
	IPRINT=0	WB19	62
	NCPT=0	WB19	63
	NBODY=0	WB19	64
	NWING=0	WB19	65
	NTAIL=0	WB19	66
	NSEG=0	WB19	67
	KOL=0	WB19	68
	REFR=1.	WB19	69
	REFC=1.	WB19	70
	REFD=1.	WB19	71
	REFL=1.	WB19	72
	REFX=0.	WB19	73
	REFZ=0.	WB19	74
	ITMAX=0	WB19	75
	CCTEST=0.	WB19	76
	REWIND 7	WB19	77
CR	REWIND 8	WB19	78
CR	REWIND 9	WB19	79
	REWIND 10	WB19	80
C		WB19	81
C	INPUT CONFIGURATION PARAMETERS	WB19	82
C		WB19	83
	READ (5,150) TITLE1	WB19	84
	IF (EOF(5).NE.0.)	WB19	85
10	WRITE (6,170) TITLE1	WB19	86
C		WB19	87
C	DEBUG PRINT CONTROL OPTIONS	WB19	88
	READ (5,180) IPRT,IXZSYN,IPLOT,NWCPT,NVTX,NVVTX,NCPOUT,NVLIN	WB19	89
	LPRT = IPRT(1),GT.0	WB19	90
	IF (LPRT) WRITE(6,220) IPRT,IXZSYN,IPLOT,NWCPT,NVTX,NVVTX,NCPOUT	WB19	91
	* ,NVLIN	WB19	92
C		WB19	93
C	VORTEX CALCULATION PARAMETERS	WB19	94
	READ (5,160) XWLE,XSTART	WB19	95
	IF (LPRT) WRITE(6,290) XWLE,XSTART	WB19	96
C		WB19	97
C	GEOMETRY DEFINITION OPTIONS	WB19	98
	READ (5,190) J0,J1,J2,J3,J4,J5,J6,NWAF,NWAFOR,NFUS,	WB19	99
1	(NRAOK(I),NFURX(I),I=1,4),NP,NPOODR,NF,NFINDR,NCAN,NCANOR	WB19	100
	IF (LPRT) WRITE(6,230) J0,J1,J2,J3,J4,J5,J6,NWAF,NWAFOR,NFUS	WB19	101

1	,KRADX,KFORX,NP,NPCOR,KF,KFINOR,KCAN,KCANOR	WB19 102
C		WB19 103
C	INPUT DESCRIPTION AND INITIALIZATION	WB19 104
C	SET BOUNDARY CONDITION AND WING THICKNESS OPTIONS	WB19 105
C		WB19 106
30	CALL COMFIG	WB19 107
CDC	CALL OVERLAY (LWH,1,1)	WB19 108
	READ (5,150) TITLE2	WB19 109
	IF (LPRT) WRITE(6,170) TITLE2	WB19 110
	READ (5,140) LINHC,ITWICK,IPRINT,LCPA,LCPB,LCPC,ITMAX,CCTEST	WB19 111
	IF (LPRT) WRITE(6,240)	WB19 112
	* LINHC,ITWICK,IPRINT,LCPA,LCPB,LCPC,ITMAX,CCTEST	WB19 113
	IF (LINHC.GT.0) LBC=TRUE.	WB19 114
	IF (LCP,AND,ITWICK.GT.0) THK=TRUE.	WB19 115
C		WB19 116
C	INPUT REVISED CONFIGURATION PANELING DESCRIPTION CONTROL INTEGERS	WB19 117
C		WB19 118
	READ (5,180) K0,K1,K2,K3,K4,K5,K6,KWAF,KWAFOR,KFUS,	WB19 119
	1 (KRADX(I),KFORX(I),I=1,4)	WB19 120
	IF (LPRT) WRITE(6,250) K0,K1,K2,K3,K4,K5,K6,KWAF,KWAFOR,KFUS,	WB19 121
	1 (KRADX,KFORX	WB19 122
	TAIL=FALSE.	WB19 123
	IF (K4.GT.0.OR,K5.GT.0) TAIL=TRUE.	WB19 124
	IF (TAIL)	WB19 125
	1 READ (5,180) (KF(I),KFINOR(I),I=1,6),(KAN(I),KANOR(I),I=1,6)	WB19 126
	IF (LPRT,AND,TAIL) WRITE(6,260) KF,KFINOR,KAN,KANOR	WB19 127
C		WB19 128
CH40	READ (9) REFA	WB19 129
	IF (K0.EQ.0) GO TO 50	WB19 130
	READ (5,160) REFAF,REFB,REFC,REFD,REFL,REFX,REFZ	WB19 131
	IF (LPRT) WRITE (6,270) REFAF,REFB,REFC,REFD,REFL,REFX,REFZ	WB19 132
	IF (REFAF.EQ.0.) REFA=REFAF	WB19 133
	IF (REFB.EQ.0.) REFB=1.	WB19 134
	IF (REFC.EQ.0.) REFC=1.	WB19 135
	IF (REFD.EQ.0.) REFD=1.	WB19 136
	IF (REFL.EQ.0.) REFL=1.	WB19 137
C		WB19 138
C	GENERATE GEOMETRY IN ORDER WING, V, TAIL, H, TAIL, BODY	WB19 139
C		WB19 140
50	CONTINUE	WB19 141
	IF (KRADX(1),LF,21) GO TO 70	WB19 142
	WRITE (6,200)	WB19 143
	STOP 200	WB19 144
70	CONTINUE	WB19 145
C		WB19 146
C	READ AND COMPUTE BODY VORTEX GEOMETRY REQUIRED -----	WB19 147
C		WB19 148
	CALL READVX (NFUS,NFORX,LPRT)	WB19 149
C		WB19 150
C	REVISE BODY (FUSELAGE) MERIDIAN LINE SPACING, THEN	WB19 151
C	REVISE AXIAL PANEL SPACING ON BODY (FUSELAGE) AND	WB19 152
C	COMPUTE NEW PANEL GEOMETRY	WB19 153
C		WB19 154
	CALL NEWRAD	WB19 155
	CALL BODPAN	WB19 156
CDC	CALL OVERLAY (LWH,1,4)	WB19 157
CDC	CALL OVERLAY (LWH,1,5)	WB19 158
C		WB19 159
C	WRITE CONTROL POINTS ON TAPE4 -----	WB19 160
C	IF NCPOUT.GT.0, PRCPT GENERATES CONTROL POINT FOR VPATHL	WB19 161
C	IF NCPOUT=2, STOP AFTER WRITING POINTS	WB19 162
C		WB19 163
	IF (NCPOUT.GT.0) CALL PRCPT(NBODY)	WB19 164

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C      CALL CPUTIM (TIME,DT,1)
C      IF (IPRINT.LT.0) WRITE(6,210) TIME,DT
C      RETURN
C
140  FORMAT (7I3,F7.0)
150  FORMAT (8A10)
160  FORMAT (10F7.0)
170  FORMAT (///5X,8A10,25X,12H** GEOM ** )
180  FORMAT (24I5)
200  FORMAT (100,46HERROR= BODY HAS MORE THAN 20 COLUMNS OF PANELS)
210  FORMAT(///10X,16HEND GEOM , , TIME=F10.3,5X,3HDT=F10.3)
220  FORMAT(///5X,52HADDITIONAL PRINT OPTIONS (IPRT) * XZ-PANEL SYMMETRY
*      //43H IN GEOM VORTEX VEL SOLN IXZSYN //617
*      //5X,20HPLOT OPTIONS (IPLOT)
*      //28H GEOM CP U/V/W //417
*      //5X,26HVORTEX CALCULATION CONTROL
*      //35H NCPT NVTX NVVIX NCPOUT NVLIN //517)
230  FORMAT(///10X,37HJ=DATA CARDS REQUIRED (NO=0,YES=NE,0)
*      //40H REFA WING BODY POD V,FIN H,TAIL XY=SYN
*      //49H J0 J1 J2 J3 J4 J5 J6 //717
*      //21H WING GEOM: KMAF=,15,3X,7HMKAFOR=,15,
*      //21H BODY GEOM: KMF=,15,4X,6HMKRADOX=,415
*      //30X,6HMKFORX=,415
*      //21H POD GEOM: KPF=,15,3X,7HMKPFOR=,15
*      //21H V,FIN GEOM: KVF=,15,3X,7HMKVFOR=,15
*      //21H H,TAIL GEOM: KCAF=,15,3X,7HMKCAFOR=,15)
240  FORMAT(///50H LINHC THICK IPRINT LCPA LCPB LCPC ITMAX
*      //7H CCFST, //717,F10.5)
250  FORMAT(///10X,44H=DATA CARDS, ADDITIONAL CARDS FOR PANELING
*      //50H REF WING BODY V/A V,FIN H,TAIL N/A
*      //50H K0 K1 K2 K3 K4 K5 K6 //717
*      //22H WING PANEL: KMAF=,15,3X,7HMKAFOR=,15,
*      //22H BODY PANEL: KMF=,15,4X,6HMKRADOX=,415
*      //31X,6HMKFORX=,415)
260  FORMAT(10H V,FIN PANEL,16X,7H KVF=,615, //30X,7HMKVFOR=,615
*      //10H H,TAIL PANEL,16X,7H KCAF=,615, //30X,7HMKCAFOR=,615)
270  FORMAT(///10X,23HPANEL REFERENCE LENGTHS
*      //4X,5HREFAR,6X,4HREFR,6X,4HREFC,6X,4HREFD,6X,4HREFL
*      //6X,4HREFX,6X,4HREFZ, //F10.3)
290  FORMAT (//6X,4HYLE,4X,6HXSTART //2F10.3)
END

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WR19 165
WR19 166
WR19 167
WR19 168
WR19 169
WR19 170
WR19 171
WR19 172
WR19 173
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WR19 176
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WR19 206
WR19 207

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SUBROUTINE INVERT(A,IA,NROWS)
C
C MATRIX INVERSION == GAUSS-JORDAN ELIMINATION WITHOUT PIVOTING
C
C DIMENSION IPIVOT(60),INDX(60),INDX(60),A(NROWS,NROWS)
N=IA
DO 10 J=1,N
IPIVOT(J)=0
CONTINUE
DO 100 I=1,
I=0
DO 30 J=1,
IF (IPIVOT(J).EQ.1) GO TO 30
DO 20 K=1,
IF (IPIVOT(K).EQ.1) GO TO 20

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WR20 1
WR20 2
WR20 3
WR20 4
WR20 5
WR20 6
WR20 7
WR20 8
WR20 9
WR20 10
WR20 11
WR20 12
WR20 13
WR20 14
WR20 15

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	IF (.NOT.(ABS(A(J,K))-ABS(1,GT,0.)) GO TO 20	NR20	16
	IROW=J	NR20	17
	ICOL=K	NR20	18
	T=A(J,K)	NR20	19
20	CONTINUE	NR20	20
30	CONTINUE	NR20	21
	IPIVOT(ICOL)=IPIVOT(ICOL)+1	NR20	22
	IF (IROW.EQ.ICOL) GO TO 50	NR20	23
	DO 40 L=1,N	NR20	24
	T=A(IROW,L)	NR20	25
	A(IROW,L)=A(ICOL,L)	NR20	26
	A(ICOL,L)=T	NR20	27
40	CONTINUE	NR20	28
50	INDXR(I)=IROW	NR20	29
	INDXC(I)=ICOL	NR20	30
	PIVOT=A(ICOL,ICOL)	NR20	31
	IF (PIVOT.EQ.0.) GO TO 130	NR20	32
	A(ICOL,ICOL)=1.	NR20	33
	DO 70 L=1,N	NR20	34
	A(ICOL,L)=A(ICOL,L)/PIVOT	NR20	35
70	CONTINUE	NR20	36
	DO 90 L=1,N	NR20	37
	IF (L.EQ.ICOL) GO TO 90	NR20	38
	T=A(L,ICOL)	NR20	39
	A(L,ICOL)=0.	NR20	40
	DO 80 M=1,N	NR20	41
	A(L,M)=A(L,M)-A(ICOL,M)*T	NR20	42
80	CONTINUE	NR20	43
90	CONTINUE	NR20	44
100	CONTINUE	NR20	45
	DO 120 I=1,N	NR20	46
	L=N+1-I	NR20	47
	IF (INDXR(L).EQ.INDXC(L)) GO TO 120	NR20	48
	IROW=INDXR(L)	NR20	49
	ICOL=INDXC(L)	NR20	50
	DO 110 K=1,N	NR20	51
	T=A(K,IROW)	NR20	52
	A(K,IROW)=A(K,ICOL)	NR20	53
	A(K,ICOL)=T	NR20	54
110	CONTINUE	NR20	55
120	CONTINUE	NR20	56
	RETURN	NR20	57
130	WRITE (6,140)	NR20	58
	STOP	NR20	59
140	FORMAT (1H0,30HERROR - THE MATRIX IS SINGULAR)	NR20	60
	END	NR20	61

	SUBROUTINE ITRATE	NR21	1
C		NR21	2
C	SOLVE THE BOUNDARY CONDITION EQUATIONS BY AN ITERATIVE METHOD AND	NR21	3
C	DETERMINE THE STRENGTHS OF THE BODY SOURCES AND THE WING, FIN	NR21	4
C	(VERTICAL TAIL), AND CANARD (HORIZONTAL TAIL) VORTICES.	NR21	5
C		NR21	6
	COMMON /POINT / D(60,60),DNH(600),DNH(600),Z6(1200)	NR21	7
	COMMON NH(600),NH(600),NT(600),A(600),R*(600),NR(600),	NR21	8
	I 27(21600),G*(600),GB(600),GT(600)	NR21	9
	COMMON /PARAM / NHODY,NWING,NTAIL,LHC,THK,XMACH,ALPHA,BETA,ALPHAC	NR21	10
	I ,DNIR,REFA,REFR,REFC,REFD,REFL,REFX,REFZ	NR21	11
	COMMON /VELCOM/ NPOINT,NPART,IMAX,JMAX,NMAX,EN,IPRINT,NWTHK	NR21	12

1	,NBLOCK,NBROW(20),NBBLOCK,NBBROW(60)	WB21	13
	COMMON /ITERAT/ ITMAX,CCTEST	WB21	14
	REAL NB,NA,NT	WB21	15
C		WB21	16
C	VARIABLE DEFINITIONS:	WB21	17
C	NA,NB = INPUT NORMAL VELOCITY, WING AND BODY	WB21	18
C	GA,GB = OUTPUT STRENGTH (WING AND BODY)	WB21	19
C	D = DIAGONAL BLOCK MATRIX	WB21	20
C	RW,RR = RESIDUAL NORMAL VELOCITY COMPONENT	WB21	21
C	NT,GT = TEMPORARY VECTORS FOR LAST ITERATION	WB21	22
C		WB21	23
	ITMAX=15	WB21	24
	IF (ITMAX.NE.0) ITMAX=ITMAX	WB21	25
	EPS=1.E-3	WB21	26
	IF (CCTEST.NE.0.) EPS=CCTEST	WB21	27
	REWIND 9	WB21	28
C		WB21	29
C	INITIALIZE WING AND BODY SOLUTION	WB21	30
C		WB21	31
	IF (NBODY.EQ.0) GO TO 20	WB21	32
	DO 10 N=1,NBODY	WB21	33
	NT(N)=0.	WB21	34
	RR(N)=RR(N)	WB21	35
10	CONTINUE	WB21	36
20	CONTINUE	WB21	37
C8	IF (NBWING.EQ.0) GO TO 40	WB21	38
C8	DO 30 N=1,NWING	WB21	39
C8	GT(N)=0.	WB21	40
C8	RW(N)=RW(N)	WB21	41
C830	CONTINUE	WB21	42
C		WB21	43
C	START ITERATION -----	WB21	44
C		WB21	45
40	DO 250 IT=1,ITMAX	WB21	46
	CALL CPUTIM(TIME,OT,1)	WB21	47
	IF (IAHS(IPRINT),GT.2) WRITE(6,390) IT,TIME,OT	WB21	48
	ITEST=0	WB21	49
	IR=0	WB21	50
	IR=0	WB21	51
	IF (NBODY.EQ.0) GO TO 80	WB21	52
C		WB21	53
C	COMPUTE BODY STRENGTHS FROM DIAGONAL BLOCKS - GB = 0*RR	WB21	54
C		WB21	55
	JS=0	WB21	56
	NBLOCK=NBBLOCK	WB21	57
	DO 60 NN=1,NBLOCK	WB21	58
	NROW=NBBROW(NN)	WB21	59
	NCOL=NBBROW	WB21	60
	READ (10) D	WB21	61
	DO 50 I=1,NROW	WB21	62
	IR=IR+1	WB21	63
	GB(IR)=0.	WB21	64
	DO 50 JJ=1,NCOL	WB21	65
	JJ=J+JS	WB21	66
	GB(IR)=GB(IR)+D(I,J)*RR(JJ)	WB21	67
50	CONTINUE	WB21	68
	JS=JS+NROW	WB21	69
60	CONTINUE	WB21	70
C	BODY CONVERGENCE TEST	WB21	71
	IF (IT.EQ.1) GO TO 80	WB21	72
	DO 70 N=1,NBODY	WB21	73
	IF (ABS(GB(N)-NT(N)).GE.EPS) ITEST=1	WB21	74
	IF (ITEST.EQ.1) GO TO 80	WB21	75

70	CONTINUE	WR21	76
C		WR21	77
C	COMPUTE WING STRENGTHS FROM DIAGONAL BLOCKS - GW = D*RW	WR21	78
C		WR21	79
80	CONTINUE	WR21	80
CR	IW = 0	WR21	81
CR	IF (N*ING.EQ.0) GO TO 120	WR21	82
CH	JS=0	WR21	83
CR	NHLOK=NHLOK	WR21	84
CR	DO 100 I=1,NHLOK	WR21	85
CH	NRD=ENRQ*(NN)	WR21	86
CR	NCOL=NRD*	WR21	87
CR	READ (12) 0	WR21	88
CR	DO 90 I=1,NROW	WR21	89
CH	IW=IW+1	WR21	90
CR	GW(IW)=0.	WR21	91
CR	DO 90 J=1,NCOL	WR21	92
CR	JJ=J+JS	WR21	93
CR	GW(IW)=GW(IW)+D(I,J)*RW(JJ)	WR21	94
CH90	CONTINUE	WR21	95
CH	JS=JS+NRD*	WR21	96
CH100	CONTINUE	WR21	97
CHC	WING CONVERGENCE TEST	WR21	98
CH	IF (IT.EQ.1) GO TO 120	WR21	99
CR	DO 110 N=1,NWING	WR21	100
CR	IF (ABS(GW(N)-GT(N)).GE.EPS) ITTEST=1	WR21	101
CR	IF (ITTEST.EQ.1) GO TO 120	WR21	102
CH110	CONTINUE	WR21	103
C		WR21	104
C	PRINT ITERATION INFORMATION -----	WR21	105
C		WR21	106
120	REKIND 10	WR21	107
	IF (IAHS(IPRINT).LT.3) GO TO 130	WR21	108
	WRITE (6,360) IT	WR21	109
	IF (NBODY.GT.0) WRITE (6,370) NBODY,(GB(N),N=1,NBODY)	WR21	110
	IF (NWING.GT.0) WRITE (6,380) NWING,(GW(N),N=1,NWING)	WR21	111
130	IF (IAHS(IPRINT).LT.4) GO TO 140	WR21	112
	IF (NBODY.GT.0) WRITE (6,290) NBODY,(RB(N),N=1,NBODY)	WR21	113
	IF (NWING.GT.0) WRITE (6,300) NWING,(RW(N),N=1,NWING)	WR21	114
140	IF (ITEST.EQ.0.AND.IT.GE.1) GO TO 260	WR21	115
	IF (IT.GE.IMAX) GO TO 270	WR21	116
C		WR21	117
C	COMPUTE CROSS INFLUENCE BETWEEN BLOCKS -----	WR21	118
C	BODY PANEL J ON BODY CONTROL POINT I	WR21	119
C		WR21	120
CH	IF (NBODY.EQ.0) GO TO 200	WR21	121
	DO 165 I=1,NBODY	WR21	122
	RT(I)=GB(I)	WR21	123
	DNB(I)=0.	WR21	124
	READ (9) (A(J),J=1,NBODY)	WR21	125
	IF (NBODY.LE.NMAX) GO TO 160	WR21	126
	DO 150 J=1,NBODY	WR21	127
	DNB(I)=DNB(I)+A(J)*GB(J)	WR21	128
150	CONTINUE	WR21	129
160	RB(I)=NR(I)-DNB(I)	WR21	130
165	CONTINUE	WR21	131
C	WING PANEL J ON BODY CONTROL POINT I	WR21	132
CH	IF (NWING.EQ.0) GO TO 260	WR21	133
CH240	CONTINUE	WR21	134
250	REKIND 9	WR21	135
C		WR21	136
C	PRINT ITERATION SUMMARY -----	WR21	137
260	WRITE (6,310) IT,EPS	WR21	138

GO TO 280	4R21 139
270 WRITE (6,320) IMAX,EPS	4R21 140
280 WRITE (6,330)	4R21 141
IF (NBODY.GT.0) WRITE (6,370) NBODY,(NT(N),N=1,NBODY)	4R21 142
IF (N*ING.GT.0) WRITE (6,380) N*ING,(GT(N),N=1,N*ING)	4R21 143
WRITE (6,340)	4R21 144
IF (NBODY.GT.0) WRITE (6,370) NBODY,(GB(N),N=1,NBODY)	4R21 145
IF (N*ING.GT.0) WRITE (6,380) N*ING,(GB(N),N=1,N*ING)	4R21 146
RETURN	4R21 147
290 FORMAT (2X,10HGH(N),N=1,,13/(1X,10F10.5))	4R21 148
300 FORMAT (2X,10HGN(N),N=1,,13/(1X,10F10.5))	4R21 149
310 FORMAT (1H0,29HTHE ITERATION CONVERGED AFTER,14,2X,	4R21 150
1 35HITERATIONS WITH A TEST CRITERION OF,F10.7)	4R21 151
320 FORMAT (1H0,36HTHE ITERATION DID NOT CONVERGE AFTER,14,2X,	4R21 152
1 35HITERATIONS WITH A TEST CRITERION OF,F10.7)	4R21 153
330 FORMAT (1H0,41HTHE SOLUTION AT THE PREVIOUS ITERATION IS)	4R21 154
340 FORMAT (1H0,40HTHE SOLUTION AT THE PRESENT ITERATION IS)	4R21 155
350 FORMAT (17H0ITERATION NUMBER,14)	4R21 156
370 FORMAT (2X,10HGH(N),N=1,,13/(1X,10F10.5))	4R21 157
380 FORMAT (2X,10HGN(N),N=1,,13/(1X,10F10.5))	4R21 158
390 FORMAT (/10X,25HCPU TIME IN ITRATE AT IT=,14	4R21 159
* ,5X,5HTIME=,F10.4,5X,3HDT=,F10.4)	4R21 160
END	4R21 161

SUBROUTINE MXOUT (PAR,VAL,A,N,M,LINS,IPDS,ISP,ND,MD)	4R22 1
-----	4R22 2
	4R22 3
SUBROUTINE MXOUT	4R22 4
	4R22 5
PURPOSE	4R22 6
PRODUCES AN OUTPUT LISTING OF ANY SIZED ARRAY ON	4R22 7
LOGICAL UNIT 6	4R22 8
	4R22 9
USAGE	4R22 10
CALL MXOUT (PAR,VAL,A,N,M,LINS,IPDS,ISP,ND,MD)	4R22 11
	4R22 12
DESCRIPTION OF PARAMETERS	4R22 13
PAR = ALPHANUMERIC PARAMETER NAME, HH-----	4R22 14
VAL = NUMERICAL VALUE OF PAR	4R22 15
A = NAME OF OUTPUT MATRIX	4R22 16
N = NUMBER OF ROWS IN A	4R22 17
M = NUMBER OF COLUMNS IN A	4R22 18
LINS = NUMBER OF PRINT LINES ON THE PAGE (USUALLY 60)	4R22 19
IPDS = NUMBER OF PRINT POSITIONS ACROSS THE PAGE (132)	4R22 20
ISP = LINE SPACING CODE, 1 SINGLE SPACE, 2 DOUBLE SPACE	4R22 21
3 SINGLE SPACE, NEW PAGE, 4 DOUBLE SPACE, NEW PAGE	4R22 22
ND = N DIMENSIONED SIZE OF A	4R22 23
MD = M DIMENSIONED SIZE OF A	4R22 24
	4R22 25
SUBROUTINES AND FUNCTION SUBPROGRAMS REQUIRED	4R22 26
NONE	4R22 27
	4R22 28
METHOD	4R22 29
	4R22 30
THIS SUBROUTINE CREATES A STANDARD LISTING OF ANY	4R22 31
SIZED ARRAY WITH ANY STORAGE MODE. EACH PAGE IS HEADED WITH	4R22 32
THE CODE NUMBER, DIMENSION AND STORAGE MODE OF THE ARRAY.	4R22 33
EACH COLUMN AND ROW IS ALSO HEADED WITH ITS RESPECTIVE	4R22 34
NUMBER.	4R22 35

C		*B22	36
C	-----	*B22	37
C		*B22	38
	DIMENSION A(40,40)	*B22	39
CDC	DIMENSION PAR(2)	*B22	40
1	FORMAT( / ,5X, A8,1X,F7.3 ,4X,I3,5H ROWS,4X,I3,8H COLUMNS,	*B22	41
	* 4X,4X,5HPART ,I2 )	*B22	42
2	FORMAT(1X,10HROW/COLUMN,10(1X,I3,8X))	*B22	43
3	FORMAT(1H )	*B22	44
4	FORMAT(1H ,I7,10G12,5)	*B22	45
5	FORMAT(1H0,I7,10G12,5)	*B22	46
6	FORMAT (1H1)	*B22	47
	J = 1	*B22	48
C		*B22	49
C	WRITE HEADING	*B22	50
C		*B22	51
	NEND = IPDS/12-1	*B22	52
	LEND = (LINS/(MOD(ISP-1,2)+1))-2	*B22	53
	IPAGE = 1	*B22	54
10	LSTRT = 1	*B22	55
20	IF (ISP,GE,3) WRITE (4,6)	*B22	56
	WRITE(6,1)PAR,VAL,N,M,IPAGE	*B22	57
	JNT = J+NEND-1	*B22	58
	IPAGE = IPAGE+1	*B22	59
31	IF (JNT-M) 33,33,32	*B22	60
32	JNT = M	*B22	61
33	CONTINUE	*B22	62
	WRITE(6,2)(JCUR,JCUR=J,JNT)	*B22	63
40	LTEND = LSTRT+LEND-1	*B22	64
	DO 80 L=LSTRT,LTEND	*B22	65
C		*B22	66
C	FORM OUTPUT ROW LINE	*B22	67
C		*B22	68
	DO 55 K=1,NEND	*B22	69
	KK = K+J-1	*B22	70
	JT = J+K-1	*B22	71
C		*B22	72
C	CHECK IF LAST COLUMN. IF YES GO TO 60	*B22	73
C		*B22	74
	IF (JT-M) 55,60,60	*B22	75
55	CONTINUE	*B22	76
C		*B22	77
C	END OF LINE, NOW WRITE	*B22	78
C		*B22	79
60	IF (MOD(ISP-1,2)) 65,65,70	*B22	80
65	WRITE(6,4)L,(A(L,J),J=J,KK)	*B22	81
	GO TO 75	*B22	82
70	WRITE(6,5)L,(A(L,J),J=J,KK)	*B22	83
C		*B22	84
C	IF END OF ROWS, GO CHECK COLUMNS	*B22	85
C		*B22	86
75	IF (N-L) 85,85,80	*B22	87
80	CONTINUE	*B22	88
C		*B22	89
C	END OF PAGE, NOW CHECK FOR MORE OUTPUT	*B22	90
C		*B22	91
	LSTRT = LSTRT+LEND	*B22	92
	GO TO 20	*B22	93
C		*B22	94
C	END OF COLUMNS, THEN RETURN	*B22	95
85	IF (JT-M) 90,95,95	*B22	96
90	J = JT+1	*B22	97
	GO TO 10	*B22	98
95	RETURN	*B22	99
	END	*B22	100

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SUBROUTINE NEWRAD
CDC OVERLAY (LAW,1,4)
CDC PROGRAM NEWRAD
C
C REVISE BODY (FUSELAGE) MERIDIAN LINE SPACING
C BODY DIFFERENTIATION OPTIONS FOR EACH SEGMENT:
C J2TEST = 1, CIRCULAR FUSELAGE WITH NO BODY CAMBER
C          = 2, CIRCULAR FUSELAGE WITH BODY CAMBER
C          = 3, ARBITRARY Y,Z CROSS SECTION
C KRADX = 0, USE KRADX MERIDIAN ANGLES
C        < 0, READ KRADX MERIDIAN ANGLES
C        > 0, GENERATE KRADX EQUAL SPACING MERIDIAN ANGLES
C          TOTAL NUMBER OF ANGLES MUST BE LESS THAN 21.
C IXZSYM = 0, SYMMETRIC GEOMETRY AND LOADS ASSUMED
C          = 1, GENERATE FULL SYMMETRIC CONFIGURATION
C          = -1, READ FULL CONFIGURATION (2*KRADX-1 VALUES)
C
COMMON /J2TESTS/ IZ1(8)
1 J0,J1,J2,J3,J4,J5,J6,NWAF,NWAFOR,NFUS,NRADX(4),NFORX(4)
2 NP,NPODOR,NF,NFINOR,NCAN,NCANOR,J2TEST,NW
3 IZ2(34),IPRT(5),IXZSYM
COMMON /BLOCK/ BLOCK(7500)
COMMON /PRINT / ARRAY(6000)
COMMON /READCOM/ K1,NWAF,NWAFOR,NRADX(4),NFORX(4),NFUS,NAX,K4,K5
1 KF(6),KAN(6),KFINOR(6),KANOR(6),KOL,NOCPT,LOCPT(20),XCPT(20)
C
C DIMENSION XFUS(30,4),ZFUS(30,4),ZF(30,30),FUSRAD(30,4),
1 SFUS(30,30,8),ANSIN(30),ANCOS(30),PHIN(30),PHIK(30),XK(30),
2 YF(30,30),YF(30),ZF(30),FUSAZ(30,4)
C
C EQUIVALENCE (XFUS(1,1),BLOCK(1)), (ZFUS(1,1),BLOCK(121))
* (SFUS(1,1,1),BLOCK(241)), (FUSRAD(1,1),BLOCK(361))
* (FUSAZ(1,1),BLOCK(481))
C EQUIVALENCE (YF(1,1),ARRAY(1)), (ZF(1,1),ARRAY(1801))
* (XK(1),ARRAY(3601)), (ANSIN(1),ARRAY(3661))
* (ANCOS(1),ARRAY(3691)), (PHIN(1),ARRAY(3721))
* (PHIK(1),ARRAY(3751))
C LOGICAL NEWPHI
C
C XIN(X1,Y1,X2,Y2,Y)=X1+(X2-X1)*(Y-Y1)/(Y2-Y1)
C
C NEWPHI=.FALSE.
C EPS=1.E-6
C EP2=EPS*EPS
C
C N = AXIAL STATION NUMBER
C
C N=0
C NFUS=NFUS
C KTEST=0
C RAD=1./57.2957795
C NEWJND 10
C DO 110 NFUS1,NFUS
C KRAD=NKADX/NFUS1
C KRAD=KRADX*(NFUS)
C
C J2TEST = 3 AND KRAD = 0 INDICATE AN ARBITRARY FUSELAGE WITH
C MERIDIAN LINES DEFINED BY READ IN THE GEOMETRY INPUT
C KTEST = ARBITRARY BODY INDICATOR: 0-CIR., 1-ARBITRARY
C
C IF (J2TEST.EQ.3.AND.KRAD.EQ.0) KTEST=1
C IF (KRAD.EQ.0) KRAD=KRAD
C IF (KRAD.GT.20) GO TO 130
C IF (IXZSYM.NE.0.AND.(2*KRAD-1).GT.30) GO TO 130
C IF (KRAD.LT.0) NEWPHI=.TRUE.

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WR23 1
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	KRAD=IARS(KRAD)	WR23	64
	KRADX(NFU)=KRAD	WR23	65
	NFUSQR=SFUS(NFU)	WR23	66
	FANG=FLOAT(2*(KRAD=1))	WR23	67
	DELE=6.2831853/FANG	WR23	68
C		WR23	69
C	READ NEW MERIDIAN ANGLES FOR SYMMETRIC HALF	WR23	70
C		WR23	71
	IF (NEWPHI) READ (5,160) (PHIK(K),K=1,KRAD)	WR23	72
	IF (NEWPHI .AND. IPRT(1).GT.0) WRITE(6,190) NFU,(PHIK(K),K=1,KRAD)	WR23	73
	DO 30 K=1,KRAD	WR23	74
	IF (NEWPHI) PHIR=PHIK(K)*RAD	WR23	75
	IF (.NOT. NEWPHI) PHIR=DELE*FLOAT(K-1)	WR23	76
20	PHIK(K)=PHIR	WR23	77
	IF (J2TEST.EQ.1) GO TO 30	WR23	78
	PHIR4=PHIR+4.712389	WR23	79
	ANSIN(K)=SIN(PHIR4)	WR23	80
	ANCOS(K)=COS(PHIR4)	WR23	81
30	CONTINUE	WR23	82
	KY=1+(NFU-1)*2	WR23	83
	KZ=KY+1	WR23	84
C		WR23	85
C	COMPUTE INTERMEDIATE VALUES AROUND CIRCUMFERENCE -----	WR23	86
C	MAXIAL STATION INDEX	WR23	87
	DO 100 N=1,NFUSQR	WR23	88
	NN=N+1	WR23	89
	IF (N.GT.50) GO TO 120	WR23	90
	XR(N)=XFUS(N,NFU)	WR23	91
	IF (J2TEST.EQ.3) GO TO 50	WR23	92
C		WR23	93
C	CASE 1, COMPUTE SECTION Y + Z COORDINATES FOR CIRCULAR/ELLIPTIC BODY	WR23	94
C		WR23	95
	HY=SFUSRAD(N,NFU)	WR23	96
	AZ=SFUSAZ(N,NFU)	WR23	97
	CAM=ZFUS(N,NFU)	WR23	98
	DO 40 K=1,KRAD	WR23	99
	RAD=0.0	WR23	100
	IF (HY.NE.0.)	WR23	101
	* RAD=1.0/SQRT((ANCOS(K)/HY)**2+(ANSIN(K)/AZ)**2)	WR23	102
	YR(N,K)=RAD*ANCOS(K)	WR23	103
	ZR(N,K)=RAD*ANSIN(K)+CAM	WR23	104
40	CONTINUE	WR23	105
	GO TO 100	WR23	106
C		WR23	107
C	CASE2, COMPUTE SECTION Y AND Z ORGINATES FOR NONCIRCULAR BODY	WR23	108
C	BY LINEAR INTERPOLATION	WR23	109
C	K,NN=CIRUMFERENTIAL STATION INDICES	WR23	110
C		WR23	111
50	K1=2	WR23	112
	PHIN(1)=0.	WR23	113
	YR(N,1)=SFUS(1,N,KY)	WR23	114
	ZR(N,1)=SFUS(1,N,KZ)	WR23	115
	YF(1)=YR(N,1)	WR23	116
	ZF(1)=ZR(N,1)	WR23	117
	ZC=(SFUS(1,N,KZ)+SFUS(NRAD,N,KZ))/2.	WR23	118
	DO 90 NN=2,NRAD	WR23	119
	IF (K1TEST.EQ.1) GO TO 80	WR23	120
	YF(NN)=SFUS(NN,N,KY)	WR23	121
	ZF(NN)=SFUS(NN,N,KZ)-ZC	WR23	122
	NN1=NN+1	WR23	123
	IF (YF(NN).EQ.0. .AND. ZF(NN).EQ.0.) GO TO 80	WR23	124
	IF (ABS(YF(NN)).LT.EP2) YF(NN1)=0.	WR23	125
	PHIN(NN1)=ATAN2(YF(NN),-ZF(NN))	WR23	126

DO 60 K=KI,KRAD	HR23 127
IF (PHIK(K).GT.PHIN(NN)) GO TO 70	HR23 128
YH(N,K)=YH(NN)+PHIN(NN)-PHIK(K)	HR23 129
ZH(N,K)=ZH(NN)+PHIN(NN)-PHIK(K)+ZC	HR23 130
CONTINUE	HR23 131
70 KIK	HR23 132
GO TO 40	HR23 133
C	HR23 134
C CASE 3, USE INPUT Y,Z VALUES	HR23 135
C	HR23 136
80 YH(N,NN)=SFUS(NN,N,KY)	HR23 137
ZH(N,NN)=SFUS(NN,N,KZ)	HR23 138
90 CONTINUE	HR23 139
100 CONTINUE	HR23 140
C	HR23 141
C GENERATE SYMMETRIC HALF OF BODY FOR IXZSYM=1 -----	HR23 142
C	HR23 143
IF (IXZSYM.LE.0) GO TO 106	HR23 144
DO 104 I=1,NFUSIR	HR23 145
K=KRAO	HR23 146
DO 104 J=2,KRAD	HR23 147
K=K+1	HR23 148
IK=KRAO+I+1	HR23 149
YH(N,K)=YH(N,IK)	HR23 150
ZH(N,K)=ZH(N,IK)	HR23 151
104 CONTINUE	HR23 152
KRAD=K	HR23 153
KRAIX(NFUI)=KRAO	HR23 154
106 CONTINUE	HR23 155
MAX=M	HR23 156
WRITE (10) YH,YZ,ZH	HR23 157
CONTINUE	HR23 158
RETURN	HR23 159
120 WRITE (6,140)	HR23 160
STOP 120	HR23 161
130 WRITE (6,170)	HR23 162
STOP 130	HR23 163
150 FORMAT (10F7.0)	HR23 164
170 FORMAT (40H ERROR = BODY HAS MORE THAN 20 MERIDIANS	HR23 165
* ,70X,12H** NEWRAD **)	HR23 166
180 FORMAT (40H ERROR = BODY HAS MORE THAN 60 AXIAL STATIONS	HR23 167
* ,65X,12H** NEWRAD **)	HR23 168
190 FORMAT(7H NEW=,I5,7H PHIK=,10G12.5,2(/7X,10G12.5))	HR23 169
END	HR23 170

SUBROUTINE PANEL(IP,IQ,J,K,L,NP,AP)	HR24 1
C	HR24 2
C CALCULATE PANEL GEOMETRY (BASED ON THE HYPERSONIC ARBITRARY BODY	HR24 3
C PROGRAM OF A. E. GENTRY) FOR NON-PLANAR PANELS	HR24 4
C	HR24 5
COMMON /POINT/ XPT(500),YPT(500),ZPT(500),THET(500),DELTA(500),	HR24 6
1 XC(30,20),YC(30,20),ZC(30,20),DUM(1200)	HR24 7
COMMON ZI(5000),ZO(30,20)	HR24 8
1 DIMENSION XIN(4),YIN(4),ZIN(4),XI(4),ETA(4)	HR24 9
1 REAL XX,YY,Z	HR24 10
C	HR24 11
C REORDER THE PANEL CORNER POINTS TO CORRESPOND TO GENTRY CONVENTION	HR24 12
C	HR24 13



	EPS=1.E-6	WR24	14
	J1=J-1	WR24	15
	K1=K-1	WR24	16
	XIN(1)=XC(J1,K1)	WR24	17
	XIN(2)=XC(J,K1)	WR24	18
	XIN(3)=XC(J,K)	WR24	19
	XIN(4)=XC(J1,K)	WR24	20
	YIN(1)=YC(J1,K1)	WR24	21
	YIN(2)=YC(J,K1)	WR24	22
	YIN(3)=YC(J,K)	WR24	23
	YIN(4)=YC(J1,K)	WR24	24
	IF (L,EQ,1) GO TO 10	WR24	25
	ZIN(1)=ZC(J1,K1)	WR24	26
	ZIN(2)=ZC(J,K1)	WR24	27
	ZIN(3)=ZC(J,K)	WR24	28
	ZIN(4)=ZC(J1,K)	WR24	29
	GO TO 20	WR24	30
10	ZIN(1)=ZU(J1,K1)	WR24	31
	ZIN(2)=ZU(J,K1)	WR24	32
	ZIN(3)=ZU(J,K)	WR24	33
	ZIN(4)=ZU(J1,K)	WR24	34
C		WR24	35
C	FORM DIAGONAL VECTORS	WR24	36
C	FORM VECTOR CROSS PRODUCT, N = T2 X T1	WR24	37
C		WR24	38
20	T1X=XIN(3)-XIN(1)	WR24	39
	T2X=XIN(4)-XIN(2)	WR24	40
	IF (IP,EQ,1) T2X=-T2X	WR24	41
	T1Y=YIN(3)-YIN(1)	WR24	42
	T2Y=YIN(4)-YIN(2)	WR24	43
	IF (IP,EQ,1) T2Y=-T2Y	WR24	44
	T1Z=ZIN(3)-ZIN(1)	WR24	45
	T2Z=ZIN(4)-ZIN(2)	WR24	46
	IF (IP,EQ,1) T2Z=-T2Z	WR24	47
	NX=T2Y*T1Z-T1Y*T2Z	WR24	48
	NY=T1X*T2Z-T2X*T1Z	WR24	49
	NZ=T2X*T1Y-T1X*T2Y	WR24	50
	IF (ABS(NX),LE,EPS) NX=0.	WR24	51
	IF (ABS(NY),LE,EPS) NY=0.	WR24	52
	IF (ABS(NZ),LE,EPS) NZ=0.	WR24	53
	VN=SQRT(NX*NX+NY*NY+NZ*NZ)	WR24	54
	IF (VN,EQ,0.) GO TO 30	WR24	55
C		WR24	56
C	FORM UNIT NORMAL VECTOR, THEN COMPUTE AVERAGE POINT	WR24	57
C		WR24	58
	VND=1./VN	WR24	59
	NX=NX*VND	WR24	60
	NY=NY*VND	WR24	61
	NZ=NZ*VND	WR24	62
30	AVX=.25*(XIN(1)+XIN(2)+XIN(3)+XIN(4))	WR24	63
	AVY=.25*(YIN(1)+YIN(2)+YIN(3)+YIN(4))	WR24	64
	AVZ=.25*(ZIN(1)+ZIN(2)+ZIN(3)+ZIN(4))	WR24	65
C		WR24	66
C	COMPUTE PROJECTION DISTANCE	WR24	67
C		WR24	68
	DENX*(AVX-XIN(1))+NY*(AVY-YIN(1))+NZ*(AVZ-ZIN(1))	WR24	69
	T=SQRT(T1X*T1X+T1Y*T1Y+T1Z*T1Z)	WR24	70
	IF (T,EQ,0.) GO TO 40	WR24	71
	T=1./T	WR24	72
	T1X=T1X*T	WR24	73
	T1Y=T1Y*T	WR24	74
	T1Z=T1Z*T	WR24	75
40	T2X=NY*T1Z-NZ*T1Y	WR24	76

T2Y=YZ+T1X+AX*T1Z	HR24	77
T2Z=NX+T1Y+AY*T1X	HR24	78
C	HR24	79
C COMPUTE COORDINATES OF CORNER POINTS IN REFERENCE COORDINATE	HR24	80
C SYSTEM	HR24	81
C TRANSFORM CORNER POINT TO ELEMENT COORDINATE SYSTEM (XI,ETA)	HR24	82
C WITH AVERAGE POINT AS ORIGIN	HR24	83
C	HR24	84
DO 50 N=1,4	HR24	85
XPA=XI*(N)+XX*D	HR24	86
YPA=YI*(N)+YY*D	HR24	87
ZPA=ZI*(N)+ZZ*D	HR24	88
D=0	HR24	89
XOIF=XPA-AXX	HR24	90
YOIF=YPA-AYY	HR24	91
ZOIF=ZPA-AZZ	HR24	92
XI(N)=T1X*XOIF+T1Y*YOIF+T1Z*ZOIF	HR24	93
ETA(N)=T2X*XOIF+T2Y*YOIF+T2Z*ZOIF	HR24	94
50 CONTINUE	HR24	95
C	HR24	96
C COMPUTE CENTROID	HR24	97
C OBTAIN CORNER POINTS IN SYSTEM WITH CENTROID AS ORIGIN	HR24	98
C	HR24	99
ETACK=ETA(2)-ETA(4)	HR24	100
IF (ETACK.EQ.0.) GO TO 60	HR24	101
XIO=0.	HR24	102
GO TO 70	HR24	103
60 YIO=(XI(4)*(ETA(1)-ETA(2))+XI(2)*(ETA(4)-ETA(1)))/(3.*ETACK)	HR24	104
70 ETAO=-ETA(1)/3.	HR24	105
XI(1)=XI(1)-XIO	HR24	106
XI(2)=XI(2)-XIO	HR24	107
XI(3)=XI(3)-XIO	HR24	108
XI(4)=XI(4)-XIO	HR24	109
ETA(1)=ETA(1)-ETAO	HR24	110
ETA(2)=ETA(2)-ETAO	HR24	111
ETA(3)=ETA(3)-ETAO	HR24	112
ETA(4)=ETA(4)-ETAO	HR24	113
C	HR24	114
C TRANSFORM CENTROID TO REFERENCE COORDINATE SYSTEM	HR24	115
C	HR24	116
XPT(NP)=AVX+T1X*XIO+T2X*ETAO	HR24	117
YPT(NP)=AVY+T1Y*XIO+T2Y*ETAO	HR24	118
ZPT(NP)=AVZ+T1Z*XIO+T2Z*ETAO	HR24	119
C	HR24	120
C COMPUTE PANEL INCIDENCE AND INCLINATION ANGLE	HR24	121
C COMPUTE PANEL AREA	HR24	122
C	HR24	123
DELTA(NP)=0.	HR24	124
THET(NP)=0.	HR24	125
R=SQRT(NV*Y+AZ*AZ)	HR24	126
IF (L.EQ.0) GO TO 90	HR24	127
SL=-1.	HR24	128
IF (L.EQ.2) SL=1.	HR24	129
C	HR24	130
C DELTA = ANGLE BETWEEN THE Y-AXIS AND THE LINE OF INTERSECTION	HR24	131
C WITH THE PANEL OF A PLANE PASSING THROUGH THE Y-AXIS AND THE	HR24	132
C PERPENDICULAR TO THE PANEL.	HR24	133
IF (NP.EQ.0.) DELTA(NP)=ATAN2(SL*RX,RM)	HR24	134
SP=PL/AT(1-2*IP)	HR24	135
IF (ABS(SP).LE.(EPS*EPS)) SP=0.	HR24	136
IF (IQ.EQ.1) GO TO 80	HR24	137
C	HR24	138
C THET = ANGLE BETWEEN THE Y-AXIS AND THE LINE OF INTERSECTION	HR24	139

C	OF THE PANEL WITH THE Y-Z PLANE.	WB24	140
	IF (NY,NE,0.) THET(IP)=ATAN2(SP*NY,-SP*NZ)	WB24	141
	GO TO 100	WB24	142
80	IF (NZ,NE,0.) THET(NP)=ATAN2(-SP*NZ,SP*NY)	WB24	143
	GO TO 100	WB24	144
90	IF (NX,NE,0.) DELTA(NP)=ATAN2(-NX,NM)	WB24	145
	IF (NY,EO,0.,AND,NZ,EO,0.) GO TO 100	WB24	146
	THET(NP)=ATAN2(-NY,NZ)	WB24	147
100	APR=5*(XI(3)-XI(1))*ETACK	WB24	148
	IF (IP,EO,1) APR=AP	WB24	149
	RETURN	WB24	150
	END	WB24	151

	SUBROUTINE PARTIN	WB25	1
C		WB25	2
C	FOR WING-BODY COMBINATIONS, INVERT THE MATRIX PARTITIONS (PROVIDED	WB25	3
C	THE ORDER DOES NOT EXCEED 60).	WB25	4
C		WB25	5
C	FOR ISOLATED WINGS OR BODIES, ALSO SOLVE THE BOUNDARY CONDITION	WB25	6
C	EQUATIONS AND DETERMINE THE WING VORTEX STRENGTHS OR BODY SOURCE	WB25	7
C	STRENGTHS.	WB25	8
C		WB25	9
	COMMON NW(600),NB(600),NT(600),A(60,60),Z3(300),GW(600),	WB25	10
1	GR(600),GT(600)	WB25	11
	COMMON /PARAM / NBODY,NWING,NTAIL,LHC,THK,XMACH,ALPHA,BETA,ALPHAC	WB25	12
1	,PHIP,REFR,REFB,REFC,REFD,REFL,REFX,REFZ	WB25	13
	COMMON /POINT / ARRAY(6000)	WB25	14
	DIMENSION D(60,60)	WB25	15
	EQUIVALENCE (D(1,1),ARRAY(1))	WB25	16
	REAL NW,NB,NT	WB25	17
C		WB25	18
	CALL CPUTIME(TIME,DT,1)	WB25	19
	NDIM=60	WB25	20
	REWIND 9	WB25	21
	NPANEL=NBODY+NWING	WB25	22
	IF (NWING,EO,0.OR,NBODY,EO,0) GO TO 50	WB25	23
C		WB25	24
C	INVERT DIAGONAL BLOCKS -----	WB25	25
C	INVERT BODY INFLUENCE MATRIX AND WRITE ON TAPE 10	WB25	26
C		WB25	27
	REWIND 10	WB25	28
	DO 10 I=1,NBODY	WB25	29
	READ (9) (D(I,J),J=1,NBODY)	WB25	30
10	CONTINUE	WB25	31
	CALL INVERT(D,NBODY,NDIM)	WB25	32
	WRITE (10) D	WB25	33
C		WB25	34
C	READ PAST BODY/WING INFLUENCE MATRICES	WB25	35
CB	DO 20 I=1,NBODY	WB25	36
CB	READ (9) (D(I,J),J=1,NWING)	WB25	37
CB20	CONTINUE	WB25	38
CB	DO 30 I=1,NWING	WB25	39
CB	READ (9) (D(I,J),J=1,NBODY)	WB25	40
CB30	CONTINUE	WB25	41
CB	DO 40 I=1,NWING	WB25	42
CB	READ (9) (D(I,J),J=1,NWING)	WB25	43
CB40	CONTINUE	WB25	44
CB	CALL INVERT(D,NWING,NDIM)	WB25	45
CB	WRITE (10) D	WB25	46
CB	REWIND 9	WB25	47

RE=IND 10	48
GO TO 100	49
C	50
C SOLVE ENTIRE MATRIX IF NPANEL)61 = ONLY WINGS OR ROOTS -----	51
C	52
50 DO 60 I=1, NPANEL	53
READ (9) (A(I,J),J=1, NPANEL)	54
60 CONTINUE	55
REWIND 9	56
CALL INVERT(A, NPANEL, INDIN)	57
C	58
C SUBSTITUTE WING BOUNDARY CONDITION AND COMPUTE STRENGTHS = GW	59
C	60
IF (NWXING, EQ, 0) GO TO 80	61
CH DO 70 I=1, NWXING	62
CH GW(I)=0.	63
CH DO 70 J=1, NWXING	64
CH GW(I)=GW(I)+A(I,J)*NW(J)	65
CH70 CONTINUE	66
GO TO 100	67
C	68
C SUBSTITUTE BODY BOUNDARY CONDITION AND COMPUTE STRENGTHS = GB	69
C	70
50 DO 90 I=1, NBODY	71
GB(I)=0.	72
DO 90 J=1, NBODY	73
GB(I)=GB(I)+A(I,J)*NB(J)	74
90 CONTINUE	75
100 REWIND 9	76
CALL CPUTIM(TIME, DT, 1)	77
WRITE(6, 110) TIME, DT	78
110 FORMAT(10X, 18HEND PARTIAL. TIME=F10.4, 5X, 18HDT=F10.4)	79
RETURN	80
END	81

SUBROUTINE PLOTA2 (X,Y,IOPT,NP,NBP,NC,LWID,LENG)	826	1
C-----	826	2
C	826	3
C SUBROUTINE PLOTA2	826	4
C	826	5
C PURPOSE	826	6
C ROUTINE TO GENERATE A SINGLE CHARACTER PLOT OF NC SIMULTANEOUS	826	7
C CURVES OF Y VERSUS X. THE MAIN CURVE IS STORED COLUMNWISE IN	826	8
C ARRAYS X(I,J) AND Y(I,J) AND MAY HAVE A VARIABLE NUMBER OF	826	9
C POINTS, NP(J).	826	10
C	826	11
C	826	12
C CALLING FORMAT	826	13
C CALL PLOTA2 (X,Y,IOPT,NP,NBP,NC,LWID,LENG)	826	14
C	826	15
C PARAMETERS	826	16
C NAME TYPE I/O/S DIM DESCRIPTION	826	17
C	826	18
C X,Y R I (NBP,NC) ORDINATE + ABSCISSA ARRAYS	826	19
C IOPT I I NONE OPTION FOR TYPE OF PAGE SCALING	826	20
C	826	21
C 1. USER SPECIFIES SCALE LIMITS	826	22
C 2. INTERNAL AUTOMATIC BEST SCALING	826	23
C 3. AUTOMATIC TRAP SHAPE SCALING, SES	826	24
C RATIO: 0.6*LWID/LENG = XDIFF/YDIFF	826	25
C 4. USE MAX AND MIN VALUES OF DATA	826	26

C					5, INPUT XMAX,YMIN# AUTO Y-SCALING	WR26	26
C					6, INPUT YMAX,YMIN# AUTO X-SCALING	WR26	27
C	NP	I	I	NONE	VECTOR OF NUMBER OF POINTS IN J*TH	WR26	28
C					CURVE, IF NDP=1, NP IS ASSUMED EQUAL	WR26	29
C					TO 1 FOR ALL CURVES,	WR26	30
C	NDP	I	I	NONE	FIRST DIMENSION OF ARRAYS *X,Y* IN	WR26	31
C					CALLING ROUTINE	WR26	32
C	NC	I	I	NONE	NUMBER OF SIMULTANEOUS PLOTS,	WR26	33
C					IF NC#41, CHARACTER SET REPEATS,	WR26	34
C	L*TD	I	I	NONE	*10TH OF PLOTTED REGIONS AT 10	WR26	35
C					CHARACTERS/INCH, NORMALLY=100,	WR26	36
C					FOR CRT OR T.I. TERMINALS=50,	WR26	37
C					*MAXIMUM DIMENSIONED = 100,	WR26	38
C	LENG	I	I	NONE	NUMBER OF LINES IN PLOTTED REGION	WR26	39
C					*NORMALLY=50 AT 6 LINES/INCH#	WR26	40
C					FOR 8.5" PAPER=40,	WR26	41
C						WR26	42
C	USER SUPPLIED COMMON BLOCKS					WR26	43
C	IOPT =1,5,6: /BSCALE/ XMAX,XMIN,YMAX,YMIN					WR26	44
C	COMMON /BSCALE/					WR26	45
C	NAME	TYPE	I/O/S	DIM	DESCRIPTION	WR26	46
C						WR26	47
C	XMAX	R	I/O	NONE	MAXIMUM X SCALE VALUE ACROSS PAGE	WR26	48
C	XMIN	R	I/O	NONE	MINIMUM X SCALE VALUE ACROSS PAGE	WR26	49
C	YMAX	R	I/O	NONE	MAXIMUM Y SCALE VALUE AT TOP OF PAGE	WR26	50
C	YMIN	R	I/O	NONE	MINIMUM Y SCALE VALUE DOWN PAGE	WR26	51
C						WR26	52
C	EXTERNAL REFERENCES					WR26	53
C	PLOT# SUBROUTINES: PLOT#7, PLOT#8					WR26	54
C						WR26	55
C	AUTHOR					WR26	56
C	JOSEPH MULLEN JR., NIELSEN ENGINEERING + RESEARCH, INC.					WR26	57
C	DATED: DECEMBER, 1976					WR26	58
C						WR26	59
C						WR26	60
C	-----					WR26	61
C	DIMENSION X(NDP,NC),Y(NDP,NC),XPRINT(7),NP(NC),FMT(6)					WR26	62
C	INTEGER SYMBOL(40)					WR26	63
C	COMMON /PLOT#1/ NXPR,NYPR,IXAXIS,IXAXIS,IOFFX,IOFFY,LLINE					WR26	64
C	COMMON /PLOT#2/ LINE(103)					WR26	65
C	COMMON /BSCALE/ XMAX,XMIN,YMAX,YMIN					WR26	66
C						WR26	67
C	DATA FMT/4H(7X,4H,616,4H,0,6,4H( 4X,4H(16,,4H4)) /					WR26	68
C	DATA SYMBOL/1H*,1H*,1H*,1H*,1H*,1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7					WR26	69
C	*,1H8,1H9,1H*,1H8,1H9,1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7					WR26	70
C	*,1H8,1H9,1H*,1H8,1H9,1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7					WR26	71
C	*,1H8,1H9,1H*,1H8,1H9,1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7					WR26	72
C	FIND MAX AND MIN OF X (ORDINATE) AND Y (ABSCISSA)					WR26	73
C						WR26	74
C	NPJ = 1					WR26	75
C	IF (IOPT,LT,1) IOPT=2					WR26	76
C	IF (IOPT,EG,1) GO TO 40					WR26	77
C	IF (IOPT,EG,5) GO TO 60					WR26	78
C	XMAX = X(1,1)					WR26	79
C	XMIN = X(1,1)					WR26	80
C	DO 50 J=1,NC					WR26	81
C	IF (NDP,GT,1) NPJ = NP(J)					WR26	82
C	IF (NPJ,LT,1) GO TO 50					WR26	83
C	DO 40 I=1,NPJ					WR26	84
C	XMAX = AMAX1(X(I,J),XMAX)					WR26	85
40	XMIN = AMIN1(X(I,J),XMIN)					WR26	86
50	CONTINUE					WR26	87
	IF (IOPT,EG,6) GO TO 40					WR26	88

C		NR26	89
80	YMAX = Y(1,1)	NR26	90
	YMIN = Y(1,1)	NR26	91
	DO 70 J=1,NC	NR26	92
	IF (NRP.GT.1) NPJ = NP(J)	NR26	93
	IF (NPJ.LT.1) GO TO 70	NR26	94
	DO 65 I=1,NPJ	NR26	95
	YMAX = AMAX1(Y(1,J),YMAX)	NR26	96
65	YMIN = AMIN1(Y(1,J),YMIN)	NR26	97
70	CONTINUE	NR26	98
C		NR26	99
C	DETERMINE SCALING AND ROUND OFF MAX AND MIN VALUES AND LOCATE	NR26	100
C	X- AND Y-AXES.	NR26	101
C		NR26	102
80	CALL PLOTAB(OX,DY,FNT,LNID,LENG,IUPT)	NR26	103
	NROWS = LENG+1	NR26	104
C		NR26	105
C	INITIALIZE PLOTTING BOUNDS	NR26	106
C		NR26	107
	YLID = YMAX+0.5*DY	NR26	108
	YUID = YMAX	NR26	109
	YUP = YMAX+0.5*DY	NR26	110
C		NR26	111
C	FORM UPPER BOUNDARY	NR26	112
C		NR26	113
	CALL PLOTAT (LINE,1,1)	NR26	114
	WRITE(6,1) (LINE(I),I=1,LLINE)	NR26	115
	DO 230 L=1,NROWS	NR26	116
C		NR26	117
C	INITIALIZE BLANK ROW OR X-AXIS	NR26	118
C		NR26	119
	IF (L.E.IXAXIS) CALL PLOTAT (LINE,L-IOFFX,2)	NR26	120
	IF (L.EO.IXAXIS) CALL PLOTAT (LINE,L-IOFFX,1)	NR26	121
C		NR26	122
C	TEST FOR DATA IN L*TH ROW	NR26	123
C		NR26	124
	DO 210 J=1,NC	NR26	125
	JSYM = MOD(J-1,40)+1	NR26	126
	IF (NRP.GT.1) NPJ = NP(J)	NR26	127
	IF (NPJ.LT.1) GO TO 210	NR26	128
	DO 210 I=1,NPJ	NR26	129
	IF (Y(I,J).GT.YUP) GO TO 210	NR26	130
	IF (Y(I,J).LE.YLOW) GO TO 210	NR26	131
C		NR26	132
C	FIND X LOCATION OF POINT - CHECK IF WITHIN SIDE BOUNDS	NR26	133
C		NR26	134
	NOX = IFIX((X(I,J)-XMIN)/OX+0.5)*2	NR26	135
	IF (NOX.LE.1) GO TO 210	NR26	136
	IF (NOX.GE.LLINE) GO TO 210	NR26	137
	LINE(NOX) = SYMBOL(JSYM)	NR26	138
210	CONTINUE	NR26	139
C		NR26	140
C	PRINT ROW OF OUTPUT - TEST TO WRITE SCALES	NR26	141
C		NR26	142
	IMOD = MOD(L-IOFFX-1,NYPR)	NR26	143
	IF (IMOD.EQ.0) WRITE (6,2) YUID,(LINE(I),I=1,LLINE)	NR26	144
	IF (IMOD.NE.0) WRITE (6,3) (LINE(I),I=1,LLINE)	NR26	145
C		NR26	146
C	INCREMENT Y-STRIP; REDEFINE YLOW AND YUP	NR26	147
C		NR26	148
	YUP = YUID	NR26	149
	YUID = YUID+DY	NR26	150
	IF (ABS(YUID/OY).LT.0.001) YUID=0.0	NR26	151

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      YLOW = YLOW+DY
230  CONTINUE
C
C FORM LOWER BOUNDARY
C
      CALL PLOTAT (LINE,1,1)
      WRITE (N,3) (LINE(I),I=1,LINE)
C
C PRINT SCALES
C
      NXP = (LLINE-IGFFY)/NXPR+1
      XPRINT(1) = XMIN+DX*(IUFFY-2)
      DO 240 I=2,NXP
      XPRINT(I) = XPRINT(I-1)+DX*NXP
      IF (ABS(XPRINT(I)/DX).LT.0.001) XPRINT(I)=0.0
240  CONTINUE
      WRITE(N,FMT) (XPRINT(I),I=1,NXP)
      RETURN
1    FORMAT (1H,14X,103A1)
2    FORMAT (1X,613.4,1X,103A1)
3    FORMAT (15X,103A1)
      END

```

```

      SUBROUTINE PLOTAS (X,Y,Z,NP,NOP,NC,THETA,XCG,XP,YP,ISC)
C-----
C
C SUBROUTINE PLOTAS
C
C PURPOSE
C ROUTINE TO PERFORM AN ARBITRARY ROTATION IN 3-SPACE OF (X,Y,Z)
C DATA. THE THREE DIMENSIONAL DATA IS REDUCE TO THE (X,Y)
C PROJECTION, XP,YP.
C
C CALLING FORMAT
C CALL PLOTAS (X,Y,Z,NP,NOP,NC,THETA,XCG,XP,YP,ISC)
C
C PARAMETERS
C NAME TYPE I/O/S DIM DESCRIPTION
C
C X,Y,Z R I (NOP,NC) COORDINATE POINT ARRAYS
C NP I I NONE VECTOR OF NUMBER OF POINTS IN J*TH
C CURVE
C NOP I I NONE FIRST DIMENSION OF ARRAY *X,Y,Z* IN
C CALLING ROUTINE
C NC I I NONE NUMBER OF CURVES TO BE TRANSFORMED
C THETA R I (3) ROTATION ANGLES=THETAX,THETAY,THETAZ
C (DEGREES). ROTATIONS ARE PERFORMED
C IN REVERSE ORDER.
C XCG R I (3) LOCATION OF CENTER OF ROTATION
C XCG = (XCG,YCG,ZCG)
C XP,YP R O (NOP,NC) COORDINATES OF TRANSFORMED POINT
C NOTE: YP,YP MAY BE STORED IN X,Y.
C ISC I I NONE SCALING OPTION
C 1, AUTOMATIC SCALING
C 2, AUTOMATIC SCALING ON ONLY Z
C 3, NO SCALING OF COORDINATES
C 4, INPUT SCALING VECTOR = S
C 5, INPUT XMAX,....,ZMIN = SCALE X,Y,Z
C

```

```

C      USER SUPPLIED COMMON BLOCKS
C      ISC = 4,5: /HSCAL2/ XMAX,XMIN,YMAX,YMIN,ZMAX,ZMIN,S(3)
C
C      COMMON /HSCAL2/
C      NAME      TYPE      I/O/S      DIM      DESCRIPTION
C      XMAX      R      I/O      NONE      MAXIMUM OF X DATA VALUES
C      XMIN      R      I/O      NONE      MINIMUM OF X DATA VALUES
C      YMAX      R      I/O      NONE      MAXIMUM OF Y DATA VALUES
C      YMIN      R      I/O      NONE      MINIMUM OF Y DATA VALUES
C      ZMAX      R      I/O      NONE      MAXIMUM OF Z DATA VALUES
C      ZMIN      R      I/O      NONE      MINIMUM OF Z DATA VALUES
C      S          R      I/O      NONE      VECTOR USED FOR RELATIVE SCALING
C      OF X,Y,Z COMPONENTS BEFORE ROTATION.
C
C      AUTHOR
C      JOSEPH MULLEN JR., NIELSEN ENGINEERING & RESEARCH, INC.
C      DATED: DECEMBER, 1976
C
C-----
C      DIMENSION X(NDP,NC),Y(NDP,NC),Z(NDP,NC),NP(NC)
C      DIMENSION XP(NDP,NC),YP(NDP,NC),THETA(3),XCG(3)
C      REAL RX(3,3),RY(3,3),RZ(3,3),R(3,3)
C      COMMON /HSCAL2/XMAX,XMIN,YMAX,YMIN,ZMAX,ZMIN,S(3)
C      DATA RX,RY,RZ/1.0,1.2*0.0,1.0,1.2*0.0,1.0/
C      DATA RADDEG/0.0174532926/
C      NPJ = 1
C
C      BUILD TRANSFORMATION MATRICES
C
C      COSX = COS(THETA(1)*RADDEG)
C      SINX = SIN(THETA(1)*RADDEG)
C      COSY = COS(THETA(2)*RADDEG)
C      SINY = SIN(THETA(2)*RADDEG)
C      COSZ = COS(THETA(3)*RADDEG)
C      SINZ = SIN(THETA(3)*RADDEG)
C
C      DEFINE X-ROTATION
C
C      RX(2,2) = COSX
C      RX(2,3) = -SINX
C      RX(3,2) = SINX
C      RX(3,3) = COSX
C
C      DEFINE Y-ROTATION
C
C      RY(1,1) = COSY
C      RY(1,3) = SINY
C      RY(3,1) = -SINY
C      RY(3,3) = COSY
C
C      DEFINE Z-ROTATION
C
C      RZ(1,1) = COSZ
C      RZ(1,2) = -SINZ
C      RZ(2,1) = SINZ
C      RZ(2,2) = COSZ
C
C      OBTAIN SCALING - FIND MAXIMA AND MINIMA
C
C      GO TO (100,100,150,100,150), ISC
100  XMAX = X(1,1)
    XMIN = X(1,1)

```



YMAX = Y(1,1)	WR27 100
YMIN = Y(1,1)	WR27 101
ZMAX = Z(1,1)	WR27 102
ZMIN = Z(1,1)	WR27 103
DO 120 J=1,NC	WR27 104
IF (NDP.GT.1) NPJ = NP(J)	WR27 105
IF (NPJ.LT.1) GO TO 110	WR27 106
DO 110 I=1,NPJ	WR27 107
XMAX = AMAX1(XMAX,X(I,J))	WR27 108
XMIN = AMIN1(XMIN,X(I,J))	WR27 109
YMAX = AMAX1(YMAX,Y(I,J))	WR27 110
YMIN = AMIN1(YMIN,Y(I,J))	WR27 111
ZMAX = AMAX1(ZMAX,Z(I,J))	WR27 112
ZMIN = AMIN1(ZMIN,Z(I,J))	WR27 113
110 CONTINUE	WR27 114
120 XDIFF = YMAX-XMIN	WR27 115
YDIFF = YMAX-YMIN	WR27 116
ZDIFF = ZMAX-ZMIN	WR27 117
C	WR27 118
C CHOOSE SCALING = ISC=1,5, SCALE X,Y,Z	WR27 119
C	WR27 120
GO TO (130,140,150,160,130),ISC	WR27 121
130 D = SQRT(XDIFF*XDIFF+YDIFF*YDIFF+ZDIFF*ZDIFF)	WR27 122
S(1) = D/XDIFF	WR27 123
S(2) = D/YDIFF	WR27 124
S(3) = D/ZDIFF	WR27 125
GO TO 160	WR27 126
C	WR27 127
C ISC=2, SCALE ONLY Z.	WR27 128
C	WR27 129
140 D = SQRT(XDIFF*XDIFF+YDIFF*YDIFF)	WR27 130
S(1) = 1.0	WR27 131
S(2) = 1.0	WR27 132
S(3) = D/ZDIFF	WR27 133
GO TO 160	WR27 134
C	WR27 135
C ISC=3, USE NO SCALING	WR27 136
C	WR27 137
150 S(1) = 1.0	WR27 138
S(2) = 1.0	WR27 139
S(3) = 1.0	WR27 140
C	WR27 141
C COMPUTE GLOBAL TRANSFORMATION: R = RZ*RY*RX*S	WR27 142
C	WR27 143
160 DO 180 J=1,3	WR27 144
DO 180 I=1,3	WR27 145
SUM = 0.0	WR27 146
DO 170 K=1,3	WR27 147
DO 170 L=1,3	WR27 148
170 SUM = SUM+RZ(I,K)*RY(K,L)*RX(L,J)	WR27 149
180 W(I,J) = SUM*S(J)	WR27 150
C	WR27 151
C TRANSFORM COORDINATE VARIABLES: XP = R*(X-XCG)	WR27 152
C	WR27 153
DO 210 J=1,NC	WR27 154
IF (NDP.GT.1) NPJ = NP(J)	WR27 155
IF (NPJ.LT.1) GO TO 210	WR27 156
DO 200 I=1,NPJ	WR27 157
DX = X(I,J)-XCG(1)	WR27 158
DY = Y(I,J)-XCG(2)	WR27 159
DZ = Z(I,J)-XCG(3)	WR27 160
XP(I,J) = R(1,1)*DX+R(1,2)*DY+R(1,3)*DZ	WR27 161
YP(I,J) = R(2,1)*DX+R(2,2)*DY+R(2,3)*DZ	WR27 162

200	CONTINUE	W427 163
210	CONTINUE	W427 164
	RETURN	W427 165
	END	W427 166

	SUBROUTINE PLOTAS (X,IEXP,IROUND)	W428 1
C	-----	W428 2
C		W428 3
C	SUBROUTINE PLOTAS	W428 4
C		W428 5
C	PURPOSE	W428 6
C	ROUTINE TO ROUND OFF X	W428 7
C		W428 8
C	CALLING FORMAT	W428 9
C	CALL PLOTAS (X,IEXP,IROUND)	W428 10
C		W428 11
C	PARAMETERS	W428 12
C	NAME TYPE I/O/S DIM DESCRIPTION	W428 13
C		W428 14
C	X R I/O NONE VALUE TRUNCATED AT GIVEN EXPONENT	W428 15
C	IEXP I I NONE EXPONENT AT WHICH TRUNCATION OCCURS	W428 16
C	IROUND I I NONE ROUND OFF INDICATOR:	W428 17
C	ROUND UP (+1), DOWN (=0)	W428 18
C		W428 19
C	AUTHOR	W428 20
C	JOSEPH MULLEN JR., NIELSEN ENGINEERING & RESEARCH, INC.	W428 21
C	DATE: DECEMBER, 1976	W428 22
C		W428 23
C	NOTES	W428 24
C	CALLED BY PLOT4, PLOT49, PLOT1, & IMPLOT.	W428 25
C	-----	W428 26
C	COMMON /ORUGA / IPR	W428 27
	IF (X.LT.0.0) IX = IROUND-1	W428 28
	IF (X.GE.0.0) IX = IROUND	W428 29
	YS = X	W428 30
	X = X/10.**IEXP	W428 31
	IX = IFIX(X)	W428 32
	IF (FLOAT(IABS(IX)).LT.ABS(X)) IX = IX+IX	W428 33
	X = FLOAT(IX)*10.**IEXP	W428 34
C		W428 35
	IF (IPR.GT.0) WRITE(6,10) X,IEXP,IROUND,YS	W428 36
10	FORMAT(23H PLOTAS = ROUNDING PRINT =,8H X=OUT,612.5,	W428 37
	7H IEXP=,15,8H IROUND=,14,7H X=IN,612.5)	W428 38
	RETURN	W428 39
	END	W428 40
		W428 41

	SUBROUTINE PLOTAB (UX,IEXP,APPRINT)	W429 1
C	-----	W429 2
C		W429 3
C	SUBROUTINE PLOTAB	W429 4
C		W429 5
C	PURPOSE	W429 6
C	ROUTINE TO ROUND OFF SCALING TO NEAREST ACCEPTABLE PLOTTING	W429 7
C	SCALE.	W429 8

C						WB29	9
C	CALLING FORMAT					WB29	10
C	CALL PLOTA6 (DX, IEXP, NPRINT)					WB29	11
C						WB29	12
C	PARAMETERS					WB29	13
C	NAME	TYPE	I/O/S	DIM	DESCRIPTION	WB29	14
C						WB29	15
C	DX	H	I/O	NONE	VARIABLE TO ROUNDED OFF	WB29	16
C	IEXP	I	0	NONE	EXPONENT OF ROUNDED VARIABLE	WB29	17
C	NPRINT	I	0	NONE	NUMBER OF CHARACTERS BETWEEN LABELS	WB29	18
C						WB29	19
C	AUTHOR					WB29	20
C	JOSEPH MULLEN JR., NIELSEN ENGINEERING & RESEARCH, INC.					WB29	21
C	DATED: DECEMBER, 1976					WB29	22
C						WB29	23
C	NOTES					WB29	24
C	ARRAYS XSCL AND NPR IN THIS ROUTINE DETERMINE THE *ACCEPTABLE*					WB29	25
C	VALUES TO BE USED AS EVEN INCREMENTS IN PERFORMING SCALING.					WB29	26
C	CALLED BY PLOTA6, PLOTA9, PLUTI, & IRPLOT.					WB29	27
C						WB29	28
C	-----					WB29	29
C	COMMON /ORUGA / IPH					WB29	30
C	DIMENSION XSCL(6), NPR(4)					WB29	31
C	DATA XSCL/2.,2.5,4.,5.,8.,10./					WB29	32
C	DATA NPR /25,20,25,20,25,20/ ,XSCL/6/					WB29	33
C	DATA OXSAVE /1.0/					WB29	34
C						WB29	35
C	ABSX = ABS(DX)					WB29	36
C	IF (ABSX.LE.0.) WRITE(6,10) DX					WB29	37
C	IF (ABSX.LE.0.) ABSX=OXSAVE					WB29	38
C	IF (ABSX.GT.0.) OXSAVE=ABSX					WB29	39
10	FORMAT(///5'2H *),45H WARNING = ILLEGAL DATA TO BE SCALED (PLOTA6)					WB29	40
C	* ,6H = DX,G20,13,5(2H *)					WB29	41
C						WB29	42
C	DETERMINE EXPONENT OF DX					WB29	43
C	AL = ALOG10(ABSX)					WB29	44
C	IEXP = AL					WB29	45
C	IF (ABSX.LT.1.) IEXP=IEXP-1					WB29	46
C	AL = DX					WB29	47
C						WB29	48
C	SET ABSX BETWEEN 1 AND 10					WB29	49
C	ABSX = ABSX/10.**IEXP					WB29	50
C						WB29	51
C	COMPARE WITH & LOCATE ACCEPTABLE SCALE					WB29	52
C	ON 80 I=1, NSCL					WB29	53
C	IF (ABSX.LE.XSCL(I)) GO TO 85					WB29	54
80	CONTINUE					WB29	55
C	I = NSCL					WB29	56
85	ABSX = XSCL(I)					WB29	57
C	NPRINT = NPR(I)					WB29	58
C						WB29	59
C	RETURN SCALED VALUES					WB29	60
C	DX = SIGN(ABSX,DX)*10.**IEXP					WB29	61
C	IF (IPH.GT.0) WRITE(6,12) DX,IEXP,NPRINT,I,AL					WB29	62
12	FORMAT(23H PLOTA6 = DEBUG PRINT =,4H DX=OUT,612.5,7H IEXP=,15,					WB29	63
C	* 4H NPRINT=,14,4H I=,13,7H DX=IN,612.5)					WB29	64
C	RETURN					WB29	65
C	END					WB29	66

```

SUBROUTINE PLOTAT (LINE,L,IOPT)                                *R30 1
-----*R30 2
C                                                                    *R30 3
C SUBROUTINE PLOTAT                                           *R30 4
C                                                                    *R30 5
C PURPOSE                                                    *R30 6
C ROUTINE TO INITIALIZE A ROW OF PLOTTED OUTPUT. THE ARRAY LINE *R30 7
C IS INITIALIZED WITH THE BORDER AND WITH X- AND Y-AXES.      *R30 8
C                                                                    *R30 9
C CALLING FORMAT                                              *R30 10
C CALL PLOTAT (LINE,L,IOPT)                                  *R30 11
C                                                                    *R30 12
C PARAMETERS                                                  *R30 13
C NAME TYPE I/O/S DIM DESCRIPTION                            *R30 14
C LINE I O NONE VECTOR CONTAINING LINE OF OUTPUT.          *R30 15
C L I I NONE LATH ROW OF OUTPUT                             *R30 16
C IOPT I I NONE OPTION: IOPT=1, INITIALIZE LINE AS          *R30 17
C BOUNDARY OR AXIS                                          *R30 18
C IOPT=2, INITIALIZE LINE AS BLANK                          *R30 19
C                                                                    *R30 20
C AUTHOR                                                      *R30 21
C JOSEPH MULLEN JR., NIELSEN ENGINEERING + RESEARCH, INC.    *R30 22
C DATED: DECEMBER, 1976                                       *R30 23
C                                                                    *R30 24
C NOTES                                                       *R30 25
C CALLED BY APLOT, PLOTAT, PLOTAT2, + PLOTAT2              *R30 26
C                                                                    *R30 27
C THE DATA VARIABLES DASH, SLASH, BLANK, AND SLASHI DETERMINE THE *R30 28
C CHARACTERS WHICH MAKE UP THE PLOT BORDER AND TICK MARKS.  *R30 29
C THIS IS THE ONLY STATEMENT REQUIRED TO CHANGE THESE CHARACTER *R30 30
C REPRESENTATIONS.                                           *R30 31
C                                                                    *R30 32
-----*R30 33
C                                                                    *R30 34
C INTEGER DASH,SLASH,BLANK,SLASHI,SYM,LINE(103)            *R30 35
C COMMON /MPLTA1/ NXPR,NYPR,IXAXIS,IXAXIS,IOFFY,IOFFY,LLINE *R30 36
C DATA DASH,SLASH,BLANK,SLASHI/1H-,1H.,1H.,1H./           *R30 37
CIRM DATA DASH,SLASH,BLANK,SLASHI/1H-,1H.,1H.,1H./        *R30 38
C SYM = SLASH                                                *R30 39
C LMI = LLINE-1                                              *R30 40
C                                                                    *R30 41
C SET Y-SCALE TICK MARKS                                     *R30 42
C IF (MOD(L-1,NYPR/2),EQ,0) SYM = DASH                      *R30 43
C LINE(1) = SYM                                              *R30 44
C LINE (LLINE) = SYM                                         *R30 45
C IF (IOPT,EQ,2) GO TO 200                                    *R30 46
C                                                                    *R30 47
C INITIALIZE BOUNDARY WITH X-SCALE TICK MARKS               *R30 48
C DO 70 J=2,LMI                                              *R30 49
C LINE(J) = DASH                                              *R30 50
C IS = MOD(IOFFY,10)                                          *R30 51
C IF (IS,LE,0) IS=IS+10                                       *R30 52
C DO 80 J=IS,LMI,10                                          *R30 53
C LINE(J) = SLASH                                             *R30 54
C DO 90 J=IOFFY,LMI,NYPR                                      *R30 55
C LINE(J) = SLASHI                                            *R30 56
C RETURN                                                      *R30 57
C                                                                    *R30 58
C INITIALIZE BLANK ROW                                        *R30 59
C DO 210 I=2,LMI                                             *R30 60
C LINE(I) = BLANK                                             *R30 61
C IF (IXAXIS,GT,0) LINE(IXAXIS) = SYM                       *R30 62
C                                                                    *R30 63

```

RETURN  
END

NR30 64  
NR30 65

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SUBROUTINE PLOTAB (DX,DY,FMT,LWID,LENG,IOPT)                                NR31 1
-----
SUBROUTINE PLOTAB                                                            NR31 2
NR31 3
NR31 4
NR31 5
PURPOSE                                                                      NR31 6
NR31 7
ROUTINE TO SELECT SCALES, AND ROUND MAX AND MIN VALUES TO                NR31 8
ACCEPTABLE VALUES, AND LOCATE X= AND Y=AXES.                             NR31 9
NR31 10
CALLING FORMAT                                                                NR31 11
CALL PLOTAB (DX,DY,FMT,LWID,LENG,IOPT)                                     NR31 12
NR31 13
PARAMETERS                                                                    NR31 14
NAME      TYPE  I/O/S  DIM  DESCRIPTION                                NR31 15
NR31 16
DX         I      I/O   NONE  X DATA INCREMENT (OUTPUT)          NR31 17
DY         I      I/O   NONE  Y DATA INCREMENT (OUTPUT)          NR31 18
FMT        H      I/O   (6)   OBJECT TYPE FORMAT FOR PRINTING    NR31 19
X=AXIS SCALES.                                                            NR31 20
LWID       I      I     NONE  WIDTH OF PLOT (NO. OF CHARACTERS)   NR31 21
LENG       I      I     NONE  LENGTH OF PLOT (NO. OF CHARACTERS)  NR31 22
IOPT       I      I     NONE  OPTION FOR TYPE OF PAGE SCALING    NR31 23
1, USER SPECIFIES SCALE LIMITS                                           NR31 24
2, INTERNAL AUTOMATIC BEST SCALING                                        NR31 25
3, AUTOMATIC TRUE SHAPE SCALING, USES *RATIO*                            NR31 26
RATIO: 0.6*LWID/LENG = XDIFF/YDIFF                                        NR31 27
4, USE MAX AND MIN VALUES OF DATA                                       NR31 28
5, INPUT XMAX,YMIN# AUTO Y-SCALING                                        NR31 29
6, INPUT YMAX,YMIN# AUTO X-SCALING                                        NR31 30
NR31 31
EXTERNAL REFERENCES                                                            NR31 32
PLOTAB SUBROUTINES: PLOTAB, PLOTAB                                         NR31 33
NR31 34
AUTHOR                                                                        NR31 35
JOSEPH MULLEN JR., NIELSEN ENGINEERING + RESEARCH, INC.                 NR31 36
DATED: DECEMBER, 1976                                                    NR31 37
NR31 38
NOTES                                                                        NR31 39
1. PRODUCES SCALING CONSISTENT WITH ARPLT, PLOT41, PLOT42, AND PLOT43    NR31 40
PLOT44, VALUES COMPUTED BESIDES THE ARGUMENT LIST ARE XMAX, XMIN, YMAX, NR31 41
YMIN, XPR, YPR, IXAXIS, IYAXIS, IOFFX, IOFFY, AND FMT.                   NR31 42
CALLED BY ARPLT, PLOT41, PLOT42, + PLOT43.                                NR31 43
NR31 44
2. THE DATA VARIABLE *RATIO* IN THIS ROUTINE SETS THE CHARACTER          NR31 45
SIZE *WIDTH=TO=HEIGHT RATIO FOR TRUE SHAPE SCALING. TO CHANGE            NR31 46
SET *RATIO* EQUAL TO NO. OF CHARACTERS/INCH DOWN PAGE DIVIDED           NR31 47
BY NO. OF CHARACTERS /INCH ACROSS PAGE.                                  NR31 48
NR31 49
-----
DIMENSION DX(4),DY(4),IEXP(4),NPR(4),FMT(6),FMTX(27)                    NR31 50
COMMON /PLOTAB/ XPR,NPR,IYAXIS,IXAXIS,IOFFX,IOFFY,LLINE                 NR31 51
COMMON /HSCALE/ XMAX,XMIN,YMAX,YMIN                                     NR31 52
COMMON /ORUGA / IPR                                                    NR31 53
NR31 54
DATA FMTX/ 0H0 ,0H(0X ,0H(7X ,0H(8X ,0H(9X ,0H(10X,0H(11X,0H(12X,0H(13X,0H(14X,0H(15X,0H(16X,0H(17X,0H(18X,0H(19X,0H(20X
* ,0H(13X,0H(14X,0H(15X,0H(16X,0H(17X,0H(18X,0H(19X,0H(20X
NR31 55
NR31 56
NR31 57

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* ,4H(21X,4H(22X,4H(23X,4H(24X,4H(25X,4H(26X,4H(27X,4H(28X	WH31	58
* ,4H(29X,4H(30X,4H(31X,	WH31	59
DATA 200,HALF/0.0001,0.5001/	WH31	60
C DEFINE RATIO OF PRINTED CHARACTER WIDTH-TO-HEIGHT	WH31	61
DATA RATIO/0.6/	WH31	62
C	WH31	63
C TEST FOR ILLEGAL WIDTH AND LENGTH	WH31	64
C	WH31	65
IF (LENG.LT.2) LENG=40	WH31	66
IF (LWID.GT.100) LWID=100	WH31	67
IF (LWID.LT.2) LWID=100	WH31	68
LLINE = LWID+3	WH31	69
C	WH31	70
C DOING DATA CHECK OF INPUT	WH31	71
IF (IPR.LT.0) IPR=0	WH31	72
IF (IPR.GT.0) WRITE(6,10) IPR,LWID,LENG,LLINE,XMAX,XMIN,YMAX,YMIN	WH31	73
10 FORMAT(21H PLOTAB = DEBUG PRINT =,7H IPR=,15,7H LWID=,15,	WH31	74
* 7H LENG=,15,7H LLINE=,15,7H XMAX=,612,5,	WH31	75
* 7H XMIN=,612,5,7H YMAX=,612,5,7H YMIN=,612,5)	WH31	76
C	WH31	77
XDIFF = XMAX-XMIN	WH31	78
YDIFF = YMAX-YMIN	WH31	79
DX = XDIFF/LWID	WH31	80
DY = YDIFF/LENG	WH31	81
IXPAS = 0	WH31	82
IYPAS = 0	WH31	83
C	WH31	84
C BRANCH TO APPROPRIATE TYPE OF SCALING REQUESTED	WH31	85
C	WH31	86
230 GO TO (240,250,260,240,290,300),IPRT	WH31	87
C	WH31	88
C IPR=1,4, SPECIFY X-Y SCALE LIMITS	WH31	89
C	WH31	90
240 NXPR = 20	WH31	91
NYPR = 10	WH31	92
IF (ABS(RATIO*DY/DX-1.0).LT.0.01) NYPR=12	WH31	93
GO TO 330	WH31	94
C	WH31	95
C IPR=2, COMPUTE AUTOMATIC SCALED LIMITS	WH31	96
C	WH31	97
250 CALL PLOTAB (DX,IEXP,NXPR)	WH31	98
CALL PLOTAB (DY,IEXP,NYPR)	WH31	99
NYPR = 10	WH31	100
GO TO 310	WH31	101
C	WH31	102
C IPR=3, COMPUTE AUTOMATIC TRUE SHAPE SCALES	WH31	103
C	WH31	104
260 OVI(1) = DY	WH31	105
OVI(2) = DY+RATIO	WH31	106
OVI(3) = DX	WH31	107
OVI(4) = DX/RATIO	WH31	108
CALL PLOTAB(OVI(1),IEXP(1),NPR(1))	WH31	109
CALL PLOTAB(OVI(2),IEXP(2),NPR(2))	WH31	110
CALL PLOTAB(OVI(3),IEXP(3),NPR(3))	WH31	111
CALL PLOTAB(OVI(4),IEXP(4),NPR(4))	WH31	112
OVI(1) = OVI(1)*RATIO	WH31	113
OVI(2) = OVI(2)/RATIO	WH31	114
OVI(3) = OVI(3)/RATIO	WH31	115
OVI(4) = OVI(4)*RATIO	WH31	116
DX = 4*RATIO*(OVI(1),OVI(2),OVI(3),OVI(4))	WH31	117
DO 270 I=1,4	WH31	118
IF (OVI(I).LT.OX) GO TO 270	WH31	119
IF (OVI(I).LT.OY) GO TO 270	WH31	120

```

      IF (DXI(I).GT.DXM) GO TO 270
      DXM = DXI(I)
      ITEST = I
270  CONTINUE
      DX = DXI(ITEST)
      DY = DYI(ITEST)
      IEXPX = IEXP(ITEST)
      IEXPY = IEXP(ITEST)
      IF (ITEST.LE.2) NXPR=20
      IF (ITEST.LE.2) NYPR=NYPR(ITEST)/2
      IF (ITEST.GE.3) NXPR=NYPR(ITEST)
      IF (ITEST.GE.3) NYPR=12
      GO TO 310

C
C   IOPT=5, SPECIFY X-SCALES, AUTOMATIC Y-SCALE SELECTION
C
290  NXPR = 20
      CALL PLOTA6(DY,IEXPY,NYPR)
      NYPR = 10
      GO TO 310

C
C   IOPT=6, SPECIFY Y-SCALES, AUTOMATIC X-SCALE SELECTION
C
300  NYPR = 10
      CALL PLOTA6(DX,IEXPX,NXPR)
      GO TO 320

C
C   RELOCATE AND ROUND OFF YMAX + XMIN
C   YMIN
310  IYPAS = IYPAS+1
      IF (IYPAS.GT.1) GO TO 315
      IYPAS = 1
      YMIN1 = YMIN-0.5*(DY*(LENG-YDIFF))
      CALL PLOTA6 (YDIFF,IWND,NRND)
      CALL PLOTA5 (YMIN1,IWND,0)
315  IF (YMIN1.LE.0.) YMIN1=DY*FLOAT(IFIX(YMIN1/DY+SIGN(RND,YMIN1)))
C
C       CHECK FOR ZERO AS A POSSIBLE MINIMUM SCALE
      IF (ABS(YMIN1/DY).LT.0.25) YMIN1=0.0
      IF (YMIN1.GE.0.0) YMIN=AMAX1(YMIN1,0.0)
      IF (YMIN1.LT.0.0) YMIN=YMIN1
      IF (IYPAS.GT.2) GO TO 320

C
C       CHECK FOR POSSIBLE LOSS OF DATA
      YMAX1 = YMIN+DY*LENG
      IF (YMAX1.LT.YMAX) DY=(YMAX-YMIN)/LENG
      IF (YMAX1.LT.YMAX) GO TO 260
      YMAX = YMIN+DY*LENG

C
C   XMIN
C
320  IF (IOPT.EQ.5) GO TO 330
      IXPAS = IXPAS+1
      IF (IXPAS.GT.1) GO TO 325
      IXPAS = 1
      XMIN1 = XMIN-0.5*(DX*(LWID-XDIFF))
      CALL PLOTA6 (XDIFF,IWND,NRND)
      CALL PLOTA5 (XMIN1,IWND,0)
325  XMIN1=DX*FLOAT(IFIX(XMIN1/DX+SIGN(RND,XMIN1)))
C
C       CHECK FOR ZERO AS A POSSIBLE MINIMUM SCALE
      IF (ABS(XMIN1/DX).LT.0.25) XMIN1=0.0

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WR31 121
WR31 122
WR31 123
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WR31 174
WR31 175
WR31 176
WR31 177
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WR31 179
WR31 180
WR31 181
WR31 182

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      IF (XMIN,GE,0.0) X=IN+XAXI(XMIN,0.0)
      IF (YMIN,GE,0.0 .AND. (XMAX=DX*L+ID),LE,0.0) XMIN=0.0
      IF (XMIN,LT,0.0) XMIN=XMINI
      IF (IXPAS,GT,2) GO TO 330
C
C      CHECK FOR POSSIBLE LOSS OF DATA
C
      XMAXI = XMIN+DX*L+ID
      IF (XMAXI,LT,XMAX) DX=(XMAX-XMIN)/L+ID
      IF (XMAXI,LT,XMAX) GO TO 230
      XMAX = XMIN+DX*L+ID
C
C      ESTABLISH LOCATION OF Y-AXIS, IF ANY
C
330  IF (XMIN,LT,0.0) IYAXIS=IFIX(ABS(XMIN/DX)+HALF)+2
      IF (XMIN,GE,0.0) IYAXIS=0
C
C      ESTABLISH LOCATION OF X-AXIS, IF ANY
C
      IF (YMIN,LT,0.0) IXAXIS=IFIX(ABS(YMIN/DY)+HALF)+1
      IF ((YMIN,GE,0.0).OR.(YMAX,LE,0.0)) IXAXIS=0
C
C      COMPUTE Y-SCALE OFFSET OF ZERO OR BOTTOM OF PLOT
C
      IF (YMIN,LT,0.0) IOFFY = MOD(IXAXIS,NYPR)-1
      IF (YMIN,GE,0.0) IOFFY = MOD(LNAG,NYPR)
C
C      COMPUTE X-SCALE OFFSET OF ZERO OR FIRST LABEL
C
      IF (XMIN,LT,0.) IOFFX=IYAXIS
      IF (XMIN,GE,0.) IOFFX=IFIX(-XMIN/DX-HALF)+2
      IOFFX = MOD(IOFFX,NXPR)
      IF (IOFFX,LT,2) IOFFX=IOFFX+NXPR
      IF ((IOPT,EQ,1),OR,(IOPT,EQ,5)) IOFFX=2
C
C      SET FORMAT, FMT, FOR Y-AXIS
C
      IFMT = FMTX(3,IOFFY+1)
      FMT(1) = FMTX(IFMT)
      IF (NXPR,EQ,25) FMT(4)=FMTX(5)
      IF (NXPR,EQ,20) FMT(4)=FMTX(2)
      IF (NXPR,EQ,16) FMT(4)=FMTX(1)
C
      IF (IDR,LE,0) GO TO 999
      WRITE(6,12) XMAX,XMIN,DX,NXPR,IYAXIS,IOFFY,YMAXI,XMINI,IXPAS
      WRITE(6,14) YMAX,YMIN,DY,NYPR,IYAXIS,IOFFY,YMAXI,YMINI,IYPAS
      IF (IOPT,EQ,3) WRITE(6,16) DXI,DYI,IXPR,NPY,IREST
      WRITE(6,18) FMT
12  FORMAT(20H PLOTAB = X-SCALES =,7H Y-AXIS,G12.5,7H XMIN=G12.5,
* 7H DX=G12.5,7H NXPR=,15,6H IYAXIS=,14,7H IOFFY=,14,
* /20X,7H XMAXI=G12.5,7H XMINI=G12.5,7H IYPAS=,15)
14  FORMAT(20H PLOTAB = Y-SCALES =,7H Y-AXIS,G12.5,7H YMIN=G12.5,
* 7H DY=G12.5,7H NYPR=,15,6H IYAXIS=,14,7H IOFFY=,14,
* /20X,7H YMAXI=G12.5,7H YMINI=G12.5,7H IXPAS=,15)
16  FORMAT(20H PLOTAB = IOPT=,6H DXI=,4G12.5,
* /20X,6H DYI=,4G12.5,/20X,6H IXPR=,4I12,
* /20X,6H NPY=,4I12,16X,6H IREST=,14)
18  FORMAT(20H PLOTAB = FORMAT =,7H FMT=,2X,6A4)
999  RETURN
      END

```



C	SUBROUTINE PLOTG	WR32	1
C	ROUTINE TO PLOT PANEL GEOMETRY AND ROTATE CONFIGURATION FOR	WR32	2
C	PERSPECTIVE VIEWING	WR32	3
C		WR32	4
C	DATA STORAGE (TAPE7):	WR32	5
C	1. ARRAY(6000) = WING/TAIL CORNER POINTS AND PANEL GEOMETRY	WR32	6
C	2. ARRAY(6000) = BODY CORNER POINTS	WR32	7
C		WR32	8
C	DIMENSION ARRAY(6000),X(5,300),Y(5,300),Z(5,300)	WR32	10
C	* ,CHORD(600),SLOPE(600),XP(5,300),YP(5,300)	WR32	11
C	* ,NPLT(300),XCG(3),AROT(3),LINE(3000)	WR32	12
C		WR32	13
C	COMMON /JOPTS/ IZ1(8)	WR32	14
C	1 ,J0,J1,J2,J3,J4,J5,J6,NWAF,NWAFOR,NFUS,NRADX(4),NFORX(4)	WR32	15
C	2 ,NP,NPQDOR,NF,NFINOR,NCAN,NCANOR,J2TEST,NW	WR32	16
C	3 ,IZ2(34),IPRT(5),IXZSYM	WR32	17
C	COMMON /PARAM / NBDY,NWING,NTAIL,LHC,THK,XMACH,ALPHA,BETA,ALPHAC	WR32	18
C	1 ,PHIR,REFA,REFB,REFC,REFD,REFL,REFX,REFZ	WR32	19
C	COMMON /POINT / XPT(600),YPT(600),ZPT(600),THET(600)	WR32	20
C	* ,DELTA(600),XC(30,20),YC(30,20),ZC(30,20),AREA(600),XLE(600)	WR32	21
C	COMMON BLOCK(7500)	WR32	22
C	COMMON /NE-CON/ K1,KWAF,KWAFOR,KRADX(4),KFORX(4),KFUS,NAX,K4,K5	WR32	23
C	1 ,KF(6),KAN(6),KFINDR(6),KANOR(6),KOL,NCP1,LOCPT(20),XCPT(20)	WR32	24
C	COMMON /SEG / NSEG,NROW(20),NCOL(20),COSS(20),SINS(20)	WR32	25
C	1 ,HT(20),NNT(20),HL(140)	WR32	26
C	COMMON /BSIZE / XYPT(4),ITAPE	WR32	27
C		WR32	28
C	EQUIVALENCE (ARRAY(1),XPT(1))	WR32	29
C	* ,(X(1),BLOCK(1)), (Y(1),BLOCK(1501)), (Z(1),BLOCK(3001))	WR32	30
C	* ,(XP(1),BLOCK(4501)), (YP(1),BLOCK(6001))	WR32	31
C	* ,(CHORD(1),AREA(1)), (SLOPE(1),XLE(1))	WR32	32
C	* ,(XPT(1),LINE(1))	WR32	33
C		WR32	34
C	DATA XCG,AROT/3*0., 3*0./, NPLT/300*5/	WR32	35
C	DATA IOPT,NOP,L*10,LENG/3,5,100,50/	WR32	36
C	DATA NLIN/3000/	WR32	37
C	ITAPE=9	WR32	38
C		WR32	39
C	COPY WING PANEL POINTS IN TO (X,Y,Z)	WR32	40
C		WR32	41
C	CALL CPUTIM(TIME,DT,1)	WR32	42
C	REWIND 7	WR32	43
C	JP = 0	WR32	44
C	IF (K1.EQ.0 .AND. K4.EQ.0 .AND. K5.EQ.0) GO TO 150	WR32	45
C	READ (7) ARRAY,CHORD,SLOPE	WR32	46
C	ONE = 1.	WR32	47
C	CALL MXOUT (8H XC=WING,ONE,XC,30,20,60,132,1,30,20)	WR32	48
C	CALL MXOUT (8H YC=WING,ONE,YC,30,20,60,132,1,30,20)	WR32	49
C	CALL MXOUT (8H ZC=WING,ONE,ZC,30,20,60,132,1,30,20)	WR32	50
C		WR32	51
C	DEFINE CLOSED CURVE AROUND BOUNDARY OF PANEL	WR32	52
C	POINTS ARE ACCESSED IN THE FOLLOWING ORDER	WR32	53
C	1 = (J=1,K=1) 3 = (J=1,K)	WR32	54
C	2 = (J ,K=1) 4 = (J ,K)	WR32	55
C	CURVE IS DRAWN IN FOLLOWING ORDER: (1,2,4,3,1)	WR32	56
C		WR32	57
C	IF (NSEG.EQ.0) GO TO 150	WR32	58
C	L = 1	WR32	59
C	DO 140 N=1,NSEG	WR32	60
C	NW = NROW(N)	WR32	61
C	NC = NCOL(N)	WR32	62
C		WR32	63

DO 130 K=2,NC	WA32 64
L = L+1	WA32 65
KM1 = L-1	WA32 66
C	WA32 67
DO 120 J=2,NR	WA32 68
JM1 = J-1	WA32 69
JP = JP+1	WA32 70
C 1ST CORNER	WA32 71
X(1,JP) = XC(JM1,KM1)	WA32 72
Y(1,JP) = YC(JM1,KM1)	WA32 73
Z(1,JP) = ZC(JM1,KM1)	WA32 74
C 2ND CORNER	WA32 75
X(2,JP) = XC(J,KM1)	WA32 76
Y(2,JP) = YC(J,KM1)	WA32 77
Z(2,JP) = ZC(J,KM1)	WA32 78
C 3RD CORNER	WA32 79
Y(3,JP) = XC(J,K)	WA32 80
Y(3,JP) = YC(J,K)	WA32 81
Z(3,JP) = ZC(J,K)	WA32 82
C 4TH CORNER	WA32 83
X(4,JP) = XC(JM1,K)	WA32 84
Y(4,JP) = YC(JM1,K)	WA32 85
Z(4,JP) = ZC(JM1,K)	WA32 86
C 5TH CORNER = CLOSE CURVE	WA32 87
X(5,JP) = XC(JM1,KM1)	WA32 88
Y(5,JP) = YC(JM1,KM1)	WA32 89
Z(5,JP) = ZC(JM1,KM1)	WA32 90
IF (JP,GE,300) GO TO 250	WA32 91
120 CONTINUE	WA32 92
130 CONTINUE	WA32 93
140 CONTINUE	WA32 94
C	WA32 95
C READ BODY PANEL DATA FOR CORNER POINTS (XC,YC,ZC) -----	WA32 96
C	WA32 97
150 IF (NFUS,EG,0) GO TO 250	WA32 98
READ (7) ARRAY	WA32 99
TWO = 2.	WA32 100
C CALL XXOUT (8H XC=BODY,TWO,XC,30,20,60,132,1,30,20)	WA32 101
C CALL XXOUT (8H YC=BODY,TWO,YC,30,20,60,132,1,30,20)	WA32 102
C CALL XXOUT (8H ZC=BODY,TWO,ZC,30,20,60,132,1,30,20)	WA32 103
C	WA32 104
C COPY BODY CORNER POINTS INTO CURVES	WA32 105
C	WA32 106
L = 1	WA32 107
DO 240 IFUS=1,NFUS	WA32 108
NC = KPADX(IFUS)	WA32 109
NR = KFORX(IFUS)	WA32 110
C	WA32 111
DO 230 K=2,NC	WA32 112
L = L+1	WA32 113
KM1 = L-1	WA32 114
C	WA32 115
DO 220 J=2,NR	WA32 116
JP = JP+1	WA32 117
JM1 = J-1	WA32 118
C 1ST CORNER	WA32 119
X(1,JP) = XC(JM1,KM1)	WA32 120
Y(1,JP) = YC(JM1,KM1)	WA32 121
Z(1,JP) = ZC(JM1,KM1)	WA32 122
C 2ND CORNER	WA32 123
X(2,JP) = XC(J,KM1)	WA32 124
Y(2,JP) = YC(J,KM1)	WA32 125
Z(2,JP) = ZC(J,KM1)	WA32 126

C	3RD CORNER	WR32	127
	X(3,JP) = XC(J,K)	WR32	128
	Y(3,JP) = YC(J,K)	WR32	129
	Z(3,JP) = ZC(J,K)	WR32	130
C	4TH CORNER	WR32	131
	X(4,JP) = XC(JM1,K)	WR32	132
	Y(4,JP) = YC(JM1,K)	WR32	133
	Z(4,JP) = ZC(JM1,K)	WR32	134
C	5TH CORNER = CLOSE CURVE	WR32	135
	X(5,JP) = XC(JM1,KM1)	WR32	136
	Y(5,JP) = YC(JM1,KM1)	WR32	137
	Z(5,JP) = ZC(JM1,KM1)	WR32	138
	IF (JP,GE,500) GO TO 250	WR32	139
220	CONTINUE	WR32	140
230	CONTINUE	WR32	141
240	CONTINUE	WR32	142
C		WR32	143
C	PLOT PERSPECTIVE VIEWS OF PANEL GEOMETRY -----	WR32	144
250	CONTINUE	WR32	145
	IF (JP,LE,0) GO TO 999	WR32	146
C		WR32	147
C	TOP VIEW	WR32	148
	CALL PLOTV2(X,Y,IOPT,NPLT,NOP,JP,LWID,LENG,LINE,NLIN)	WR32	149
	WRITE(6,10)	WR32	150
C	CALL PLOTI (X,Y,IOPT,NPLT,NOP,JP,1,1,2HX*,2HY*)	WR32	151
C		WR32	152
C	SIDE VIEW	WR32	153
	CALL PLOTV2(X,Z,IOPT,NPLT,NOP,JP,LWID,LENG,LINE,NLIN)	WR32	154
	WRITE(6,11)	WR32	155
C	CALL PLOTI (X,Z,IOPT,NPLT,NOP,JP,1,1,2HX*,2HZ*)	WR32	156
C		WR32	157
C	FRONT VIEW	WR32	158
	CALL PLOTV2(Y,Z,IOPT,NPLT,NOP,JP,LWID,LENG,LINE,NLIN)	WR32	159
	WRITE(6,12)	WR32	160
C	CALL PLOTI (Y,Z,IOPT,NPLT,NOP,JP,1,1,2HY*,2HZ*)	WR32	161
C		WR32	162
C	PERSPECTIVE VIEW	WR32	163
	AROT(2) = 45.	WR32	164
	AROT(3) = -45.	WR32	165
	CALL PLOTAS(X,Y,Z,NPLT,NOP,JP,AROT,XCG,XP,YP,3)	WR32	166
	CALL PLOTV2(XP,YP,IOPT,NPLT,NOP,JP,LWID,LENG,LINE,NLIN)	WR32	167
C	CALL PLOTI (XP,YP,IOPT,NPLT,NOP,JP,1,1,3HXP*,3HYP*)	WR32	168
	WRITE(6,13) AROT	WR32	169
	CALL CPUTIM(TIME,DT,1)	WR32	170
	WRITE(6,15) TIME,DT	WR32	171
10	FORMAT(/20X,20H TOP VIEW = Y VS X )	WR32	172
11	FORMAT(/20X,20H SIDE VIEW = Z VS X )	WR32	173
12	FORMAT(/20X,20H FRONT VIEW = Z VS Y )	WR32	174
13	FORMAT(/20X,19HPERSPECTIVE VIEW =	WR32	175
	* ,7H THETA X = ,F8.3,5X,7H THETA Y = ,F8.3,5X,7H THETA Z = ,F8.3)	WR32	176
15	FORMAT(/10X,18H END PLOTG , TIME = ,F10.3,5X,3H DT = ,F10.3)	WR32	177
C		WR32	178
999	RETURN	WR32	179
	END		

	SUBROUTINE PLOTV2 (X,Y,IOPT,NP,NOP,XC,LWID,LENG,LINE,NLIN)	WR33	1
C	-----	WR33	2
C		WR33	3
C	SUBROUTINE PLOTV2	WR33	4
C		WR33	5

PURPOSE  
 ROUTINE TO GENERATE A CHARACTER PLOT OF NC SIMULTANEOUS  
 CURVES OF Y VS X. A LINEAR INTERPOLATION IS MADE BETWEEN  
 SEQUENTIAL POINTS.

# CALLING FORMAT

CALL PLOTV2 (X,Y,IOPT,NP,NOP,NC,LWID,LENG,LINE,MLIN)

## PARAMETERS

NAME	TYPE	I/O/S	DIM	DESCRIPTION
X,Y	R	I	(NOP,NC)	ORDINATE + ABSCISSA ARRAYS
IOPT	I	I	NONE	OPTION FOR TYPE OF PAGE SCALING 1, USER SPECIFIES SCALE LIMITS 2, INTERNAL AUTOMATIC BEST SCALING 3, AUTOMATIC TRUE SHAPE SCALING, USES RATIO: $0.6 * LWID / LENG = XDIFF / YDIFF$
NP	I	I	NONE	VECTOR OF NUMBER OF POINTS IN J*TH CURVE
NOP	I	I	NONE	FIRST DIMENSION OF ARRAYS *X,Y* IN CALLING ROUTINE
NC	I	I	NONE	NUMBER OF SIMULTANEOUS PLOTS, IF NC%41, CHARACTER SET REPEATS.
LWID	I	I	NONE	WIDTH OF PLOTTED REGIONS AT 10 CHARACTERS/INCH. NORMALLY=100, FOR CRT OR T.I. TERMINALS=50. MAXIMUM DIMENSIONED = 100.
LENG	I	I	NONE	NUMBER OF LINES IN PLOTTED REGION NORMALLY=50 AT 6 LINES/INCH# FOR 8.5" PAPER=40.
LINE	I	S	(MLINE)	SCRATCH MATRIX USED IN PLOTTING CHARACTERS. WHERE: (LWID+3).LE.MLIN.LE.(LWID+3)(LENG+1)
MLIN	I	I	NONE	DIMENSIONED LENGTH OF SCRATCH ARRAY *LINE*, VALUES GREATER THAN (LWID+3) ONLY IMPROVE THE EFFICIENCY OF THE PLOT ALGORITHM

## USER SUPPLIED COMMON BLOCKS

IOPT = 1,5,6; /RSCALE/ XMAX,XMIN,YMAX,YMIN

## COMMON /RSCALE/

NAME	TYPE	I/O/S	DIM	DESCRIPTION
XMAX	R	I/O	NONE	MAXIMUM X SCALE VALUE ACROSS PAGE
XMIN	R	I/O	NONE	MINIMUM X SCALE VALUE ACROSS PAGE
YMAX	R	I/O	NONE	MAXIMUM Y SCALE VALUE AT TOP OF PAGE
YMIN	R	I/O	NONE	MINIMUM Y SCALE VALUE DOWN PAGE

## EXTERNAL REFERENCES

PLOTA SUBROUTINES: PLOTA7, PLOTA8

## AUTHOR

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-----  
 DIMENSION X(NOP,NC),Y(NOP,NC),XPRIN(7),NP(NC),FMT(6)

	INTEGER SYMBOL(40),LINE(4,1)	4833	69
	COMMON /HPT,TAT/ NPT,LYPR,LYAXIS,LYXIS,LYFFX,LYFFY,LLINE	4833	70
	COMMON /HSCALE/ XMAX,XMIN,YMAX,YMIN	4833	71
C		4833	72
	DATA FMT/IN(7X,4H,G14,4H,4,6,4H( 4X,4HG16,,4H4)) /	4833	73
	DATA SYMBOL/1H,,1H,,1H,,1H,,1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7	4833	74
	,1H8,1H9,1H4,1H8,1H0,1H0,1H1,1H1,1H2,1H4,1H1,1HJ,1H1,1H1,1H1	4833	75
	,1H1,1H0,1H1,1H0,1H1,1H1,1H1,1H1,1H1,1H1,1H1,1H1,1H1,1H1,1H1	4833	76
C		4833	77
C	FIND MAX AND MIN OF X (ORDINATE) AND Y (ABSCISSA)	4833	78
C		4833	79
	NPJ = 1	4833	80
	IF (TPT,LT,1) IOPT=2	4833	81
C		4833	82
	IF (TPT,EG,1) GO TO 80	4833	83
	IF (TPT,EG,5) GO TO 80	4833	84
	XMAX = X(1,1)	4833	85
	XMIN = X(1,1)	4833	86
	DO 50 J=1,NC	4833	87
	NPJ = NP(J)	4833	88
	IF (NPJ,LT,1) GO TO 50	4833	89
	DO 40 I=1,NPJ	4833	90
	XMAX = AMAXI(X(I,J),XMAX)	4833	91
40	XMIN = AMINI(X(I,J),XMIN)	4833	92
50	CONTINUE	4833	93
	IF (TPT,EG,6) GO TO 80	4833	94
C		4833	95
60	YMAX = Y(1,1)	4833	96
	YMIN = Y(1,1)	4833	97
	DO 70 J=1,NC	4833	98
	NPJ = NP(J)	4833	99
	IF (NPJ,LT,1) GO TO 70	4833	100
	DO 65 I=1,NPJ	4833	101
	YMAX = AMAXI(Y(I,J),YMAX)	4833	102
65	YMIN = AMINI(Y(I,J),YMIN)	4833	103
70	CONTINUE	4833	104
C		4833	105
C	DETERMINE SCALING AND ROUND OFF MAX AND MIN VALUES AND LOCATE	4833	106
C	X- AND Y-AXES.	4833	107
C		4833	108
80	CALL PLOTAN(OX,OY,FMT,LWID,LENG,IOPT)	4833	109
	NROWS = LENG+1	4833	110
	NOL = MAXO(PLIN/LLINE,1)	4833	111
	IF (NOL,GT,NROWS) NOL=NROWS	4833	112
C		4833	113
C	INITIALIZE PLOTTING RAND=10TH	4833	114
C		4833	115
	YLOW = YMAX*(0.5+NOL)*OY	4833	116
	YHIG = YMAX	4833	117
	YHIG = YMAX*0.5*OY	4833	118
C		4833	119
C	FORM UPPER BOUNDARY	4833	120
C		4833	121
	CALL PLOTAT (LINE,1,1)	4833	122
	WHILE(6,1) (LINE(I),I=1,LLINE)	4833	123
C		4833	124
C	START LOOP ON COMPUTING ALL LINES THAT PASS THROUGH NEXT NOL LINES	4833	125
C		4833	126
	NRLN = NROWS/NOL	4833	127
	IF (NRLN*NOL,LT,NROWS) NRLN=NRLN+1	4833	128
	ISAVE = 0	4833	129
	DO 140 J=1,NOL	4833	130
C		4833	131

```

C INITIALIZE BLANK ROW OR X-AXIS
C
  J = JSAVE
  JK = 1
  DO 110 K=1,NOL
    J = J+1
    IF (J.GT.NROWS) GO TO 115
    IF (J.EQ.TXAXIS) CALL PLOTAT (LINE(JK),J=IOFFX,1)
    IF (J.NE.TXAXIS) CALL PLOTAT (LINE(JK),J=IOFFX,2)
    JK = JK+LLINE
110  CONTINUE
C
C TEST FOR VECTOR DRAWN ACROSS NEXT NOL LINES OF OUTPUT
C
115  DO 140 L=1,NC
    LSYM = MOD(L-1,40)+1
    NPL = NP(L)
    IF (NPL.LT.1) GO TO 140
    X2 = X(1,L)
    Y2 = Y(1,L)
C
C START LOOP ON NUMBER OF VECTORS IN EACH LINE
C
    DO 130 K=1,NPL
      X1 = X2
      Y1 = Y2
      X2 = X(K,L)
      Y2 = Y(K,L)
C
C TEST WHETHER VECTOR CROSSES BLOCK OF LINES
C
      IF ((Y1.GE.YUP).AND.(Y2.LE.YUP)) GO TO 130
      IF ((Y1.LT.YLOW).AND.(Y2.LT.YLOW)) GO TO 130
C
C COMPUTE INTERMEDIATE POINTS AND STORE IN LINE.
C
      DELX = X2-X1
      DELY = Y2-Y1
      IXX = IFIX(ABS(DELX/DX))
      IYY = IFIX(ABS(DELY/DY))
      NV = MAXD(IXX,IYY)+1
      DELX = DELX/NV
      DELY = DELY/NV
      NV = NV+1
      XV = X1
      YV = Y1
C
      DO 125 IV=1,NV
        IX = IFIX((XV-XMIN)/DX+0.5)+2
        IY = IFIX((YV-YMIN)/DY+1.)
        IF ((IY.LT.1).OR.(IY.GT.NOL)) GO TO 120
        IF ((IX.LT.2).OR.(IX.GE.LLINE)) GO TO 120
        IXY = LLINE*(IY-1)+IX
        LINE(IXY) = SYMHOL(LSYM)
120  XV = XV+DELX
        YV = YV+DELY
125  CONTINUE
130  CONTINUE
140  CONTINUE
C
C PRINT NOL LINES OF OUTPUT - CHECK FOR SCALES
C
  I = JSAVE

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#R33 132
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JK = 1	WB33 195
JK2 = LLINE	WB33 196
DO 150 K=1,70L	WB33 197
J = J+1	WB33 198
IF (J.GT.NROWS) GO TO 160	WB33 199
IMOD = MOD(J-(JFFX-1,NYPR)	WB33 200
IF (IMOD.EQ.0) WRITE (6,2) YMD, (LINE(I),I=JK,JK2)	WB33 201
IF (IMOD.NE.0) WRITE (6,3) (LINE(I),I=JK,JK2)	WB33 202
JK = JK+LLINE	WB33 203
JK2 = JK+LLINE	WB33 204
C	WB33 205
C INCREMENT Y-STRIP; REDEFINE YLOW AND YUP	WB33 206
C	WB33 207
YUP = YUP+DY	WB33 208
YMD = YMD+DY	WB33 209
IF (ABS(YMD/DY).LT.0.001) YMD=0.0	WB33 210
YLOW = YLOW+DY	WB33 211
150 CONTINUE	WB33 212
JSAVE = J	WB33 213
160 CONTINUE	WB33 214
C	WB33 215
C FORM LOWER BOUNDARY	WB33 216
C	WB33 217
CALL PLNTA7 (LINE,1,1)	WB33 218
WRITE (6,3) (LINE(I),I=1,LLINE)	WB33 219
C	WB33 220
C PRINT SCALES	WB33 221
C	WB33 222
NXP = (LLINE-JOFFY)/NXPR+1	WB33 223
XPRINT(1) = XMIN+DX*(JOFFY-2)	WB33 224
DO 240 I=2,NXP	WB33 225
XPRINT(I) = XPRINT(I-1)+DX*NXP	WB33 226
IF (ABS(XPRINT(I)/DX).LT.0.001) XPRINT(I)=0.0	WB33 227
240 CONTINUE	WB33 228
WRITE(6,FMT) (XPRINT(I),I=1,NXP)	WB33 229
RETURN	WB33 230
1 FORMAT (1H1,10X,103A1)	WB33 231
2 FORMAT (1X,6I3,4,1X,103A1)	WB33 232
3 FORMAT (15X,103A1)	WB33 233
END	WB33 234

SUBROUTINE PRESS(NP,XMACH,ARA,U,V,W,CP,CPSTAG,CPCRT,CPVAC,COMPT)	WB34 1
C	WB34 2
C THE PRESSURE COEFFICIENT IS CALCULATED USING THE EXACT ISENTROPIC	WB34 3
C FORMULA IN ALL CASES EXCEPT FOR WING, CANARD (HORIZONTAL TAIL),	WB34 4
C AND FIN (VERTICAL TAIL) COMPONENTS ANALYZED UNDER THE PLANAR	WB34 5
C BOUNDARY CONDITION OPTION. IN THESE CASES, THE LINEARIZED THEORY	WB34 6
C PRESSURE COEFFICIENT FORMULA IS USED AND THE PRESSURE COEFFICIENT	WB34 7
C IS LIMITED BY THE VACUUM PRESSURE COEFFICIENT.	WB34 8
C	WB34 9
C COMPUTE THE STAGVATION PRESSURE COEFFICIENT, CRITICAL PRESSURE	WB34 10
C COEFFICIENT, AND VACUUM PRESSURE COEFFICIENT.	WB34 11
C	WB34 12
COMMON /PAWAM / NHDDY,OWING,NTAIL,LRC,THK,AMACH,ALPHA,BETA,ALPHAC	WB34 13
1 ,PHIR,REFA,REFR,REFC,REFD,PEFL,REFX,REFZ	WB34 14
DIMENSION H(1),V(1),W(1),CPP(1)	WB34 15
INTEGER COMPT	WB34 16
LOGICAL LRC	WB34 17

X=2*XMACH*XMACH	NR34	18
CPCRT=0.	NR34	19
CPSTAG=1.	NR34	20
CPVAC=0.	NR34	21
COSARA=COS(ARA)	NR34	22
SINARA=SIN(ARA)	NR34	23
IF (XM2.EQ.0.) GO TO 10	NR34	24
CON1=.42857/XM2	NR34	25
CPVAC=-CON	NR34	26
CON1=.2*XM2	NR34	27
C	NR34	28
C LOOP THROUGH NP=PANELS TO CALCULATE PRESSURE COEFFICIENTS -----	NR34	29
C	NR34	30
10 DO 40 J=1,NP	NR34	31
U=PM=U(J)*COSARA+V(J)*SINARA	NR34	32
IF (LBC.AND.COMPT.EQ.2) GO TO 20	NR34	33
U=IND=1.+U=PM	NR34	34
V=IND=V(J)	NR34	35
W=IND=W(J)*COSARA-U(J)*SINARA	NR34	36
VW2=V*IND+V*IND+W*IND+W*IND	NR34	37
Q2=U*IND+U*IND+V*2	NR34	38
IF (XMACH.EQ.0.) GO TO 30	NR34	39
ARG=1.+CON1*(1.-Q2)	NR34	40
IF (ARG.LT.0.) ARG=0.	NR34	41
CPP(J)=CON*(ARG**3.5-1.)	NR34	42
GO TO 40	NR34	43
20 CPP(J)=-2.*U(J)	NR34	44
C	NR34	45
C CONSTRAIN THE PRESSURE COEFFICIENT SO THAT IT DOES NOT	NR34	46
C EXCEED THE VACUUM PRESSURE COEFFICIENT	NR34	47
C	NR34	48
IF (CPP(J).LT.CPVAC) CPP(J)=CPVAC	NR34	49
GO TO 40	NR34	50
30 CPP(J)=1.-Q2	NR34	51
40 CONTINUE	NR34	52
IF (XMACH.EQ.0.) RETURN	NR34	53
CPSTAG=CON*((1.+CON1)**3.5-1.)	NR34	54
CPCRT=CON*((5./6.+XM2/6.)*3.5-1.)	NR34	55
RETURN	NR34	56
END	NR34	57

SUBROUTINE PRICPT(NBODY)	NR35	1
C	NR35	2
C ROUTINE TO PRINT A COPY OF THE CONTROL POINTS AFT OF *XSTART*	NR35	3
C AND FORWARD OF *XMLE* ON TAPE4 FOR USE BY OTHER PROGRAMS	NR35	4
C	NR35	5
COMMON /JNPTMS/ IZ1(59),NVLIN	NR35	6
* ,NCPNUT,XSTART,XMLE,NXCPT,IPLUT(4),IPHT(5),IXZSY*	NR35	7
COMMON /PRINT / XPT(600),YPT(600),ZPT(600),THET(600),DELTA(600),	NR35	8
1 XC(30,20),YC(30,20),ZC(30,20),DELT(600),XLE(600)	NR35	9
C	NR35	10
IF (NXCPT.NE.0) GO TO 999	NR35	11
IF (NVLIN.GT.0) GO TO 999	NR35	12
WRITE(6,750)	NR35	13
PF=IND 4	NR35	14
IJ = 0	NR35	15
DO 100 I=1,NBODY	NR35	16
IF (XPT(I).LT.XSTART) GO TO 100	NR35	17



IF (XPT(I),GT,X*LE) GO TO 100	WR35	18
IJ = IJ+1	WR35	19
WRITE(4,745) IJ,XPT(I),YPT(I),ZPT(I)	WR35	20
WRITE(6,745) IJ,XPT(I),YPT(I),ZPT(I)	WR35	21
100 CONTINUE	WR35	22
ENDFILE 4	WR35	23
IF (NCPDUT,EQ,2) STOP 500	WR35	24
999 RETURN	WR35	25
C	WR35	26
750 FORMAT(1H1,9X,42H SUMMARY OF CONTROL POINTS WRITTEN ON TAPE4	WR35	27
* ,58X,12H** PRICPT **)	WR35	28
745 FORMAT(15,3G12,5)	WR35	29
END	WR35	30

SUBROUTINE READVX (NFUS,NFORX,LPRT)	WR36	1
C	WR36	2
C ROUTINE TO READ THE VORTEX LOCATIONS AND STRENGTHS OF BODY VORTICES	WR36	3
C	WR36	4
DIMENSION XFUS(30,4),FUSBY(30,4),FUSAZ(30,4),NFORX(4)	WR36	5
LOGICAL LPRT	WR36	6
C	WR36	7
COMMON /HVRTX / NVTX,NXVTX,XV(10),AV(10),BV(10)	WR36	8
COMMON        BLOCK(7500)	WR36	9
C	WR36	10
EQUIVALENCE (XFUS(1,1),BLOCK(1))	WR36	11
*      (FUSBY(1,1),BLOCK(361))      (FUSAZ(1,1),BLOCK(481))	WR36	12
C	WR36	13
IF (NXVTX,LE,0) GO TO 999	WR36	14
C	WR36	15
C READ VORTEX PATH X-STATIONS	WR36	16
READ (5,160) (XV(I),I=1,NXVTX)	WR36	17
IF (LPRT) WRITE(6,170) (XV(I),I=1,NXVTX)	WR36	18
C	WR36	19
C INTERPOLATE IN GEOMETRY FOR MAJOR AND MINOR AXES,	WR36	20
C B AND A RESPECTIVELY.	WR36	21
C	WR36	22
DO 120 K=1,NXVTX	WR36	23
FIND GEOMETRY BODY STATION	WR36	24
DO 100 NFU=1,NFUS	WR36	25
NFUSOR=NFORX(NFU)	WR36	26
DO 100 J=2,NFUSOR	WR36	27
IF (XV(K),LE,XFUS(J,NFU)) GO TO 110	WR36	28
100 CONTINUE	WR36	29
J = NFUSOR	WR36	30
NFU = NFUS	WR36	31
110 JM1 = J-1	WR36	32
DX = XFUS(J,NFU)-XFUS(JM1,NFU)	WR36	33
IF (DX,NE,0.) DX=(XV(K)-XFUS(JM1,NFU))/DX	WR36	34
C	WR36	35
INTERPOLATE FOR A AND B	WR36	36
C	WR36	37
AV(K) = FUSAZ(JM1,NFU)+DX*(FUSAZ(J,NFU)-FUSAZ(JM1,NFU))	WR36	38
BV(K) = FUSBY(JM1,NFU)+DX*(FUSBY(J,NFU)-FUSBY(JM1,NFU))	WR36	39
120 CONTINUE	WR36	40
IF (LPRT) WRITE(6,180) (BV(I),I=1,NXVTX)	WR36	41
IF (LPRT) WRITE(6,190) (AV(I),I=1,NXVTX)	WR36	42
999 RETURN	WR36	43
C	WR36	44

160	FORMAT(10F7.0)	WR36	45
170	FORMAT(///,10X,30HVORTEX LOCATIONS AND BODY AXES,	WR36	46
	* 70X,12H** READUXX **,//5H XV=,10F10.4)	WR36	47
180	FORMAT(//5H HV=,10F10.4)	WR36	48
190	FORMAT(//5H AZ=,10F10.4)	WR36	49
	END	WR36	50

	SUBROUTINE RDVEL(VA,WA,XPT,YPT,ZPT,NBODY,XSTART,X*LE)	WR37	1
C		WR37	2
C	ROUTINE TO READ VELOCITY COMPONENTS AT CONTROL POINTS DEFINED IN	WR37	3
C	PRTCPT.	WR37	4
C		WR37	5
	DIMENSION VA(1),WA(1),XPT(1),YPT(1),ZPT(1)	WR37	6
	REWIND 4	WR37	7
C		WR37	8
	WRITE(6,750)	WR37	9
	DO 100 I=1,NBODY	WR37	10
	IF (XPT(I).LT.XSTART) GO TO 100	WR37	11
	IF (XPT(I).GT.X*LE) GO TO 100	WR37	12
	READ(4,745) IJ,XCP,YCP,ZCP,VA(I),WA(I)	WR37	13
	IF (END(4).NE.0.) GO TO 100	WR37	14
	WRITE(6,745) I,XPT(I),YPT(I),ZPT(I),VA(I),WA(I)	WR37	15
100	CONTINUE	WR37	16
	RETURN	WR37	17
C		WR37	18
745	FORMAT(15,5612.5)	WR37	19
750	FORMAT(141,9X,34HVORTEX VELOCITIES READ FROM TAPE4 ,	WR37	20
	* 56X,12H** RDVEL **,	WR37	21
	* //4X,141,3X,3HXPT,9X,3HYPT,9X,3HZPT,10X,2HVA,10X,2HWA//)	WR37	22
	END	WR37	23

	SUBROUTINE SCAMP4(X,Y,N,NDA,NDB,DA,DB,C,S,M)	WR38	1
C		WR38	2
C	GIVEN A SET OF N POINTS WHOSE ABSCISSAE FORM A STRICTLY MONOTONIC	WR38	3
C	SEQUENCE, AND GIVEN A FIRST OR SECOND DERIVATIVE AT X(1) AND A	WR38	4
C	FIRST OR SECOND DERIVATIVE AT X(N), TO FIND THE SMOOTHEST POSSIBLE	WR38	5
C	CURVE PASSING RIGOROUSLY THROUGH THE GIVEN POINTS, SATISFYING THE	WR38	6
C	SPECIFIED BOUNDARY CONDITIONS, AND POSSESSING CONTINUOUS FIRST AND	WR38	7
C	SECOND DERIVATIVES. THE CRITERION OF SMOOTHNESS IS THE	WR38	8
C	MINIMIZATION OF THE INTEGRAL OF THE SQUARE OF THE SECOND	WR38	9
C	DERIVATIVE, AND THE CURVE FOUND IS ACCORDINGLY A CHAIN OF CURVES,	WR38	10
C	I. E., A SEPARATE CURVE ON EACH INTERVAL (X(I),X(I+1))	WR38	11
C		WR38	12
	DIMENSION C(4,1),S(1),X(1),Y(1),Z(4)	WR38	13
	L=1	WR38	14
	K=1	WR38	15
	D1=DA	WR38	16
	D2=DB	WR38	17
	IF (M.NE.12) GO TO 10	WR38	18
	K=2	WR38	19
10	IF ((NDA+1).LT.0) D1=DERIV2(X,Y,X)	WR38	20
	IF ((NDA+1).EQ.0) D1=DERIV1(X,Y,1)	WR38	21
	NA=IABS(NDA)	WR38	22
60	IF ((NDB+1).LT.0) D2=DERIV2(X(N-3),Y(N-3),X(N))	WR38	23
	IF ((NDB+1).EQ.0) D2=DERIV1(X(N-2),Y(N-2),3)	WR38	24

	NR=IABS(NOH)	NR38	25
	CALL COMCU(D1,D2,S,X,Y,M,N,NA,NS)	NR3A	26
	IF (M,NE,0) RETURN	NR3A	27
	K=1	NR3A	28
	DO 50 J=1,K	NR3A	29
	CALL CURIC2(X(J),Y(J),S(J),Z,M)	NR3A	30
	IF (M,EQ,1) GO TO 20	NR38	31
	M=100+J+M	NR3A	32
	RETURN	NR3A	33
20	IF (KK,EQ,2) GO TO 40	NR3A	34
	DO 50 I=1,4	NR38	35
	C(I,J)=Z(I)	NR3A	36
30	CONTINUE	NR3A	37
	GO TO 50	NR3A	38
40	L=7+J	NR38	39
	C(L=5,1)=X(J)	NR3A	40
	C(L=5,1)=X(J+1)	NR38	41
	C(L=4,1)=3.	NR38	42
	C(L=3,1)=Z(1)	NR38	43
	C(L=2,1)=Z(2)	NR38	44
	C(L=1,1)=Z(3)	NR38	45
	C(L,1)=Z(4)	NR38	46
50	CONTINUE	NR38	47
	NR0	NR3A	48
	RETURN	NR3A	49
	END	NR38	50

	SUBROUTINE SOLVE	NR39	1
CDC	OVERLAY (L=8,3,0)	NR39	2
CDC	PROGRAM SOLVE	NR39	3
C		NR39	4
C	SOLVE FOR THE STRENGTHS OF THE BODY SOURCES AND WING VORTICES	NR39	5
C	WHICH SATISFY THE BOUNDARY CONDITION OF TANGENTIAL FLOW AT THE	NR39	6
C	PANEL CONTROL POINTS, ALSO DETERMINE THE CORRESPONDING PRESSURE	NR39	7
C	DISTRIBUTION AND THE FORCES AND MOMENTS ON THE CONFIGURATION.	NR39	8
C		NR39	9
C	THE PROGRAM MUST SOLVE A SYSTEM OF LINEAR EQUATIONS OF MAXIMUM	NR39	10
C	ORDER 1200. THE SOLUTION TECHNIQUE SELECTED CAN BE DESCRIBED AS A	NR39	11
C	BLOCKED JACOBI ITERATIVE METHOD, THE 1200 BY 1200 MATRIX IS	NR39	12
C	NATURALLY PARTITIONED INTO FOUR 600 BY 600 BLOCKS. EACH PARTITION	NR39	13
C	IS FURTHER SUBDIVIDED INTO BLOCKS OF MAXIMUM SIZE 60 BY 60. THE	NR39	14
C	MATRIX ELEMENTS IN EACH BLOCK ARE CAREFULLY CHOSEN TO REPRESENT	NR39	15
C	SOME WELL DEFINED FEATURE OF THE ORIGINAL CONFIGURATION. FOR	NR39	16
C	EXAMPLE, A BODY BLOCK REPRESENTS THE INFLUENCE OF ONE RING OF	NR39	17
C	PANELS AROUND THE BODY, WHILE A WING BLOCK REPRESENTS THE	NR39	18
C	INFLUENCE OF ONE CHORDWISE COLUMN OF WING PANELS. FOR WINGS USING	NR39	19
C	THE NON-PLANAR BOUNDARY CONDITION OPTION, THE BLOCK SIZE	NR39	20
C	CORRESPONDS TO THE TOTAL NUMBER OF PANELS ON THE UPPER AND LOWER	NR39	21
C	SURFACES OF THE COLUMN. THIS ENSURES DOMINANCE OF THE ELEMENTS	NR39	22
C	ALONG THE DIAGONAL	NR39	23
C		NR39	24
C	THE INITIAL ITERATION CALCULATES THE SINGULARITY STRENGTHS	NR39	25
C	CORRESPONDING TO EACH BLOCK IN ISOLATION. FOR THIS STEP, ONLY THE	NR39	26
C	DIAGONAL BLOCKS ARE PRESENT IN THE AERODYNAMIC MATRIX. ONCE THE	NR39	27
C	INITIAL APPROXIMATION TO THE SINGULARITY STRENGTHS IS DETERMINED,	NR39	28
C	THE INTERFERENCE EFFECT OF EACH BLOCK ON ALL THE OTHERS IS	NR39	29
C	CALCULATED BY MATRIX MULTIPLICATION. THE INCREMENTAL NORMAL	NR39	30
C	VELOCITIES OBTAINED ARE SUBTRACTED FROM THE NORMAL VELOCITIES	NR39	31
C	SPECIFIED BY THE BOUNDARY CONDITIONS. THIS PROCESS IS ITERATED	NR39	32

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C UNTIL A CONVERGENCE TEST ON THE MAXIMUM RESIDUAL IS SATISFIED OR A  WR39 33
C MAXIMUM NUMBER OF ITERATIONS IS REACHED.  WR39 34
C ----- WR39 35
C BODY ONLY VERSION: JUNE 1977 WR39 36
C THOSE PORTIONS OF THE ORIGINAL PROGRAM *UNAERO* WHICH PERTAINED WR39 37
C TO CALCULATIONS OF WINGS HAVE BEEN DELETED. WR39 38
C JOE MULLEN WR39 39
C ----- WR39 40
C WR39 41
C TAPE USAGE IN SOLVE= WR39 42
C TAPE7: SOLVE, READ ARRAY - CALCULATE BOUNDARY CONDITION WR39 43
C DIAGIN, READ D - INVERT DIAGONALS, N GT NMAX WR39 44
C SOLVE, REWIND WR39 45
C READ ARRAY - CALCULATE NORMAL VELOCITIES WR39 46
C REWIND WR39 47
C WR39 48
C TAPE8: SOLVE, REWIND WR39 49
C READ UA,VA,WA - CALCULATE U,V,W WR39 50
C REWIND WR39 51
C WR39 52
C TAPE9: PARTIN, REWIND WR39 53
C READ D - INVERT DIAGONAL BLOCKS, N LT NMAX WR39 54
C REWIND WR39 55
C DIAGIN, REWIND WR39 56
C READ D - INVERT DIAGONAL BLOCKS, N LT NMAX WR39 57
C ITERATE, REWIND WR39 58
C READ A - ITERATE WITH AIC FOR SOLN WR39 59
C WR39 60
C TAPE10: PARTIN, REWIND WR39 61
C WRITE D(INVERSE) WR39 62
C REWIND WR39 63
C DIAGIN, REWIND WR39 64
C WRITE D(INVERSE) = DIAGONAL BLOCKS WR39 65
C REWIND WR39 66
C ITERATE, REWIND WR39 67
C READ D(INVERSE) = ITERATE ON SOLUTION WR39 68
C WR39 69
C COMMON /JOPTNS/ IZ1(50),NVLIN WR39 70
C * ,NCPDUT,XSTART,XMLE,NACPT,IPLGT(4),IPRT(5),IXZSYM WR39 71
C COMMON U(600),V(600),W(600),A(60,60),Z3(300),GW(600), WR39 72
C 1 GR(600),DZTDX(600) WR39 73
C COMMON /PARAM/ NBDY,NWING,NTAIL,LBC,THK,XMACH,ALPHA,BETA,ALPHAC WR39 74
C 1 ,PHIR,REFA,REFB,REFC,REFD,REFL,REFX,REFZ WR39 75
C COMMON /VELCOM/ NPOINT,NPART,IMAX,JMAX,KMAX,EM,IPRINT,NWTHK WR39 76
C 1 ,NWBLOK,NWROW(20),NWBLOK,NBROW(60) WR39 77
C COMMON /POINT / ARRAY(6000) WR39 78
C COMMON /MATCOM/ MATIN WR39 79
C WR39 80
C DIMENSION UA(600),VA(600),WA(600),CP(600),NS(600),CHORD(600) WR39 81
C 1 ,THET(600),DELTA(600),NB(600),NW(600),NT(600),DEL(600) WR39 82
C 2 ,COSTH(600),XPT(600),YPT(600),ZPT(600) WR39 83
C WR39 84
C EQUIVALENCE (U(1),NW(1)) WR39 85
C 1 ,(V(1),NH(1)), (N(1),NT(1)) WR39 86
C 2 ,(UA(1),A(1,1)), (VA(1),A(1,11)) WR39 87
C 3 ,(WA(1),A(1,21)), (CP(1),A(1,31)) WR39 88
C 4 ,(NS(1),A(1,41)), (GW(1),DEL(1)) WR39 89
C 5 ,(GH(1),COSTH(1)) WR39 90
C 6 ,(XPT(1),ARRAY(601)) WR39 91
C 7 ,(ZPT(1),ARRAY(1201)) WR39 92
C 8 ,(DELTA(1),ARRAY(2401)) WR39 93
C REAL NH,NW,NT,NS: WR39 94
C INTEGER COMPT WR39 95

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	LOGICAL LRC,THK	WR39	9A
	DATA RADDEG/0.0174532926/	WR39	97
C		WR39	9A
	CALL CPUTIN(TIME0,NT,1)	WR39	99
	EM=YMACH	WR39	100
	VPASS=0	WR39	101
	REWIND 7	WR39	102
	REWIND 8	WR39	103
	ALP=ALPHA*RADDEG	WR39	104
	ALPHAC=ALPHA	WR39	105
	PHI=PHIP*RADDEG	WR39	106
	SINAL=SIN(ALP)	WR39	107
	COSAL=COS(ALP)	WR39	108
	SINB=0.	WR39	109
	SINA=SINAL	WR39	110
C		WR39	111
C		WR39	112
C	ALPHAC.....INCLUDED ANGLE OF ATTACK	WR39	113
C	PHI.....ANGLE OF ROLL	WR39	114
C	ALPHA.....ANGLE OF PITCH	WR39	115
C	BETA.....ANGLE OF SIDE SLIP	WR39	116
C	ALL IN DEGREES.	WR39	117
C		WR39	118
C		WR39	119
	IF (IXZSYN,EQ,0) GO TO 5	WR39	120
	SINB=SINAL*SIN(PHI)	WR39	121
	SINA=SINAL*COS(PHI)	WR39	122
	BETA=ASIN(SINB)/RADDEG	WR39	123
	ALPHA=ASIN(SINA)/RADDEG	WR39	124
	IF (IPRINT,NE,0) WRITE(6,430) ALPHAC,PHIR,ALPHA,BETA	WR39	125
	CONTINUE	WR39	126
S		WR39	127
C		WR39	128
C	CALCULATE NORMAL VELOCITIES REQUIRED TO SATISFY BOUNDARY	WR39	129
C	CONDITIONS AT BODY CONTROL POINTS	WR39	130
C		WR39	131
20	IF (NRBODY,EQ,0) GO TO 70	WR39	132
C		WR39	133
C	BOUNDARY CONDITION FOR BODY,CONTRIBUTION FROM FREE STREAM.	WR39	134
C		WR39	135
	READ (7) ARRAY	WR39	136
	DO 30 I=1,NRBODY	WR39	137
	AM(I)=COSAL*SIN(DELTA(I))	WR39	138
	1 +COS(DELTA(I))*(-SINA+COS(THET(I))-SINB*SIN(THET(I)))	WR39	139
30	CONTINUE	WR39	140
C		WR39	141
C	-----	WR39	142
C	SOLVE MATRIX EQUATIONS - DIRECT SOLUTION IF MATRIX LESS THAN 60X60,	WR39	143
C	OTHERWISE ITERATIVE SOLUTION	WR39	144
C		WR39	145
70	IF (NRBODY.LE,NMAX,AND,N*ING.LE,NMAX) GO TO 80	WR39	146
	IF (NATIN,EQ,1) CALL DIAGIN	WR39	147
	REWIND 10	WR39	148
	GO TO 90	WR39	149
80	CALL PARTIN	WR39	150
	IF (NRBODY,EQ,0,OR,N*ING,EQ,0) GO TO 100	WR39	151
90	CALL ITRATE	WR39	152
100	REWIND 7	WR39	153
110	VPASS=VPASS+1	WR39	154
	IF (NRBODY,EQ,0) GO TO 220	WR39	155
C		WR39	156
C	CALCULATE VELOCITY COMPONENTS ON BODY PANELS	WR39	157
C	U = UA*GB, V = VA*GB, W = WA*GB	WR39	158
C		WR39	159

DO 100 I=1,NBODY	NR39 159
U(I)=0.	NR39 160
V(I)=0.	NR39 161
W(I)=0.	NR39 162
READ (H) (UA(J),VA(J),WA(J),J=1,NBODY)	NR39 163
DO 150 J=1,NBODY	NR39 164
U(I)=U(I)+UA(J)*GB(J)	NR39 165
V(I)=V(I)+VA(J)*GB(J)	NR39 166
W(I)=W(I)+WA(J)*GB(J)	NR39 167
150 CONTINUE	NR39 168
140 CONTINUE	NR39 169
C	NR39 170
C CALCULATE WING VELOCITY COMPONENTS HERE DUE TO VORTEX SHEDDING -----	NR39 171
C FROM ANGE: V = V+V(VOR), W = W+W(VOR)	NR39 172
C	NR39 173
IF (NPASS.EQ.1) READ (7) ARRAY	NR39 174
DO 145 I=1,NBODY	NR39 175
VA(I)=0.	NR39 176
145 WA(I)=0.	NR39 177
C	NR39 178
C COMPUTE VORTEX VELOCITIES BY INTERPOLATION IN STRENGTHS USING VVELS	NR39 179
C	NR39 180
CALL ELBOVT (VA,WA,XPT,YPT,ZPT,NBODY)	NR39 181
C	NR39 182
C READ IN VELOCITY CONTRIBUTIONS FOR CONTROL POINTS WRITTEN OUT BY	NR39 183
C PRICPT. VELOCITY COMPONENTS ARE COMPUTED BY VPATHL	NR39 184
C	NR39 185
IF (NVLIN.EQ.1 .AND. NCPRT.LE.0)	NR39 186
* CALL RDVEL(VA,WA,XPT,YPT,ZPT,NBODY,XSTART,XWLE)	NR39 187
C	NR39 188
C COMPUTE NORMAL VELOCITIES AT CONTROL POINTS	NR39 189
C	NR39 190
DO 190 I=1,NBODY	NR39 191
NS(I)=(W(I)*COS(THET(I))-V(I)*SIN(THET(I)))*COS(DELTA(I))-U(I)*	NR39 192
1 SIN(DELTA(I))	NR39 193
190 CONTINUE	NR39 194
IF (IAH3(IPRINT).LT.2) GO TO 210	NR39 195
WRITE (6,350) EM,ALPHAC,PHIC	NR39 196
WRITE (6,400)	NR39 197
DO 200 N=1,NBODY	NR39 198
WRITE (6,420) N,GB(N),U(N),V(N),W(N),NS(N),VA(N),WA(N)	NR39 199
200 CONTINUE	NR39 200
C	NR39 201
C CALCULATE PRESSURES ON BODY PANELS, THEN	NR39 202
C CALCULATE FORCES AND MOMENT ON BODY	NR39 203
C	NR39 204
210 COMPT=1	NR39 205
DO 150 I=1,NBODY	NR39 206
V(I) = V(I)+VA(I)	NR39 207
150 W(I) = W(I)+WA(I)	NR39 208
CALL PRESS(-HORY,EM,ALP,U,V,W,CP,CPSTAG,CPCRT,CPVAC,COMPT)	NR39 209
CALL FURHOM(NBODY,NPASS,ALP,COMPT,.FALSE.)	NR39 210
C	NR39 211
C COMPUTE FORCE AND MOMENTS FOR CONTROL POINTS BETWEEN XSTART AND XWLE	NR39 212
C	NR39 213
CALL FURHOM(-HORY,NPASS,ALP,COMPT,.TRUE.)	NR39 214
220 CONTINUE	NR39 215
340 WRITE (6,390) CPSTAG,CPCRT,CPVAC	NR39 216
RETIME=7	NR39 217
C	NR39 218
CALL CPRTIME(TIME,DT,1)	NR39 219
RTIME=TIME	NR39 220
WRITE (6,440) TIME,DT	NR39 221

	RETURN	WR39 222
350	FORMAT (///10X,16HVELOCITY ON BODY,84X,12H** SOLVE **,	WR39 223
	* //5X,5HMAC=,F6.5,3X,6HALPHA=,F7.3,3X,5HPRIR=,F7.3//)	WR39 224
390	FORMAT (/9H CPSTAG =,F10.5,3X,8HCPCRIT =,F10.5,3X,7HCPVAC =,F10.5)	WR39 225
400	FORMAT (8X,5HPANEL,3X,6HSOURCE, 7X,5HAXIAL,10X,7HLATERAL,10X,	WR39 226
	1 8HVERTICAL,10X,6HNORMAL,8X,10HLAT,VORTEX,7X,10HVEF,VORTEX	WR39 227
	2 //8X,3HNO,,4X,8HSTRENGTH,4X,8HVELOCITY,5(9X,8HVELOCITY))	WR39 228
420	FORMAT (I12,F10.5,G15.5,SG17.5)	WR39 229
430	FORMAT(/10X,25HCOMBINED ANGLES OF ATTACK,75X,12H** SOLVE **	WR39 230
	* //5X,7HALPHA=,F10.4,5X,7H PHIR=,F10.4	WR39 231
	* //5X,7H ALPHA=,F10.4,5X,7H BETA=,F10.4)	WR39 232
440	FORMAT(/5X,18HEND SOLVE, TIME=,F10.4,5X,3HDT=,F10.4)	WR39 233
	END	WR39 234

	SUBROUTINE SORPAN(UPM,VPH,WPM)	WR40 1
C		WR40 2
C	COMPUTE THE THREE COMPONENTS OF VELOCITY INDUCED AT A SPECIFIED	WR40 3
C	CONTROL POINT BY A CONSTANT SOURCE DISTRIBUTION ON A	WR40 4
C	QUADRILATERAL PANEL HAVING LONGITUDINAL TAPER AND INCLINED AT AN	WR40 5
C	ANGLE DELTA TO THE FREE STREAM DIRECTION	WR40 6
C		WR40 7
	COMMON /RODCOM/ AMACH,SA,CX,XC(4),YC(4),ZC(4),XI,YI,ZI,XJ,ZJ	WR40 8
	DIMENSION SX(4),SH(4),UX(4),DY(4),DZ(4),D(4),E(4),F(4),G(4),	WR40 9
	H(4),XPM(4),YPM(4),ZAX(4),AYM(4),RPM2(4)	WR40 10
C		WR40 11
	REAL NUM	WR40 12
	DATA EPS,PI/1,E=5,3.14195265/	WR40 13
C		WR40 14
	EP2=EPS*EPS	WR40 15
	RT2=1.-AMACH*AMACH	WR40 16
	BTA=SQRT(ABS(RT2))	WR40 17
	HA2=RT2*SA*SA	WR40 18
	TA=1.+HA2	WR40 19
	IF (TA,LT,0.) GO TO 200	WR40 20
	SH(3)=0.	WR40 21
	DO 190 I=1,4	WR40 22
	ZC(I)=ZJ-9A*(XJ-XC(I))	WR40 23
	IF (I,LE,2) SH(1)=(YC(2)-YC(1))/CX	WR40 24
	IF (I,GT,2) SH(3)=(YC(4)-YC(3))/CX	WR40 25
	SH(2)=SH(1)	WR40 26
	SH(4)=SH(3)	WR40 27
	SH=SIGN(1.,SH(I))	WR40 28
	HM2=RT2*SH(I)*SH(I)	WR40 29
	TAM=TA+HM2	WR40 30
	IF (ABS(TAM),LE,EPS) TAM=0.	WR40 31
	SAM=SQRT(ABS(TAM))	WR40 32
	SAYD=1./SAM	WR40 33
	CPH=CX*SAM	WR40 34
	UX(I)=XI-XC(I)	WR40 35
	DY(I)=YI-YC(I)	WR40 36
	DZ(I)=ZI-ZC(I)	WR40 37
	IF (ABS(UX(I)),LE,EPS) UX(I)=0.	WR40 38
	IF (ABS(DY(I)),LE,EPS) DY(I)=0.	WR40 39
	IF (ABS(DZ(I)),LE,EPS) DZ(I)=0.	WR40 40
	RPM2(I)=0.	WR40 41
	UX2=UX(I)*UX(I)	WR40 42
	DY2=DY(I)*DY(I)	WR40 43
	DZ2=DZ(I)*DZ(I)	WR40 44
	DR2=DY2+DZ2	WR40 45

	D2=DX2+HT2+DH2	WR40	44
	D(I)=0.	WR40	47
	IF (AMACH,GE,1.) DXZ=DX(I)-HTA*ABS(DZ(I))	WR40	48
	IF (AMACH,GE,1.,AND,DXZ,LT,0.) GO TO 170	WR40	49
	IF (D2,GT,0.) D(I)=SQRT(D2)	WR40	50
	XPM(I)=DX(I)+HT2*(SM(I)*DY(I)+SA*DZ(I))	WR40	51
	YMX(I)=DY(I)-SM(I)*DX(I)	WR40	52
	ZAX(I)=DZ(I)-SA*DX(I)	WR40	53
	AYM(I)=SA*DY(I)-SM(I)*DZ(I)	WR40	54
	IF (ABS(XPM(I)),LE,EPS) XPM(I)=0.	WR40	55
	IF (ABS(YMX(I)),LE,EPS) YMX(I)=0.	WR40	56
	IF (ABS(ZAX(I)),LE,EPS) ZAX(I)=0.	WR40	57
	IF (ABS(AYM(I)),LE,EPS) AYM(I)=0.	WR40	58
	IF (I,LE,2) RPM2(1)=YMX(I)**2+ZAX(I)**2+RT2*AYM(I)**2	WR40	59
	RPM2(2)=RPM2(1)	WR40	60
	IF (I,GT,2) RPM2(3)=YMX(I)**2+ZAX(I)**2+RT2*AYM(I)**2	WR40	61
	RPM2(4)=RPM2(3)	WR40	62
	IF (ABS(RPM2(I)),LE,FP2) RPM2(I)=0.	WR40	63
	RPM=SQRT(ABS(RPM2(I)))	WR40	64
	IF (RPM,LE,EPS) RPM=0.	WR40	65
	RPM=SAM*D(I)	WR40	66
	F(I)=0.	WR40	67
	DNUM=DX(I)+YMX(I)-BT2*DZ(I)+AYM(I)	WR40	68
	FNUM=D(I)*ZAX(I)	WR40	69
	IF (FNUM,EQ,0.,AND,DNUM,EQ,0.) GO TO 10	WR40	70
	IF (D(I),EQ,0.,OR,ZAX(I),EQ,0.) FNUM=0.	WR40	71
	F(I)=ATAN2(FNUM,DNUM)	WR40	72
	IF (D(I),EQ,0.) F(I)=F(I)*SIGN(1.,ZAX(I))	WR40	73
10	IF (TAM) 100,90,20	WR40	74
20	IF (AMACH,GT,1.,AND,D(I),EQ,0.) GO TO 70	WR40	75
	IF (RPM,LE,EPS) GO TO 40	WR40	76
	NUM=XPM(I)+RPM	WR40	77
	G(I)=ALOG(NUM/(B1A+RPM))+SAMD	WR40	78
	GO TO 160	WR40	79
40	SX(I)=SIGN(1.,XPM(I))	WR40	80
	IF (AMACH,LT,1.) GO TO 50	WR40	81
	IF (I,EQ,1,AND,XPM(I),LT,CPM) GO TO 130	WR40	82
	IF (I,EQ,3,AND,XPM(I),LT,CPM) GO TO 140	WR40	83
50	IF (I,EQ,2) SGN12=SX(1)*SX(2)	WR40	84
	IF (I,EQ,4) SGN34=SX(3)*SX(4)	WR40	85
	IF (XPM(I)) 60,70,80	WR40	86
60	IF (I,EQ,2,AND,SGN12,LT,0.) GO TO 130	WR40	87
	IF (I,EQ,4,AND,SGN34,LT,0.) GO TO 140	WR40	88
	G(I)=-ALOG(ABS(XPM(I)))+SAMD	WR40	89
	GO TO 160	WR40	90
70	G(I)=0.	WR40	91
	GO TO 160	WR40	92
80	G(I)=ALOG(XPM(I))+SAMD	WR40	93
	GO TO 160	WR40	94
90	G(I)=0.	WR40	95
	IF (XPM(I),GT,HTA+RPM) G(I)=D(I)/XPM(I)	WR40	96
	GO TO 160	WR40	97
100	G(I)=0.	WR40	98
	ARG=SIGN(1.,XPM(I))	WR40	99
	IF (RPM,EQ,0.) ARG=XPM(I)/(HTA+RPM)	WR40	100
	IF (ARG,GE,1.) GO TO 160	WR40	101
	IF (ARG,LE,-1.) GO TO 110	WR40	102
	IF (D(I),GT,0.) G(I)=ACOS(ARG)+SAMD	WR40	103
	GO TO 160	WR40	104
110	AM2=SA+SA+SM(I)*SM(I)	WR40	105
	TRM1=(SM(I)*DY(I)+SA*DZ(I)+ABS(AYM(I)+SAM))/AM2	WR40	106
	IF (DX(I),GT,TRM1) GO TO 120	WR40	107
	F(I)=0.	WR40	108



	IF (SSM.GT.0.) F(I)=PI*SIGN(1.,ZAX(I))	WR40 109
	GO TO 160	WR40 110
120	IF (SSM*YMX(I).GE.0.) GO TO 160	WR40 111
	G(I)=PI*SMO	WR40 112
	GO TO 160	WR40 113
130	G(1)=500.*SMO	WR40 114
	IF (AMACH.LT.1.) G(2)=-G(1)	WR40 115
	GO TO 160	WR40 116
140	G(3)=500.*SMO	WR40 117
	IF (AMACH.LT.1.) G(4)=-G(3)	WR40 118
160	H(I)=0.	WR40 119
	HARG=HTA*DY(I)	WR40 120
	IF (D(I).EQ.0..AND.HARG.EQ.0.) GO TO 180	WR40 121
	IF (AMACH.LT.1.) H(I)=HTA*.5*ALOG((D(I)+HARG)/(D(I)-HARG))	WR40 122
	IF (AMACH.GT.1.) H(I)=HTA*ATAN2(D(I),HARG)	WR40 123
	GO TO 180	WR40 124
170	F(I)=G.	WR40 125
	G(I)=0.	WR40 126
	H(I)=0.	WR40 127
	AYM(I)=0.	WR40 128
	YMX(I)=0.	WR40 129
	ZAX(I)=0.	WR40 130
	XPX(I)=0.	WR40 131
	DPX=0.	WR40 132
	RPX=0.	WR40 133
	RPX2(2)=RPX2(1)	WR40 134
	RPX2(4)=RPX2(3)	WR40 135
180	E(I)=H(I)+HT2*SM(I)*G(I)	WR40 136
190	CONTINUE	WR40 137
	TAD=1./TA	WR40 138
	F14=(E(1)-E(2)-E(3)+E(4))*TAD	WR40 139
	F14=(F(1)-F(2)-F(3)+F(4))*TAD	WR40 140
	G14=G(1)-G(2)-G(3)+G(4)	WR40 141
	R4PI=1./(4.*PI)	WR40 142
	IF (AMACH.GT.1.) R4PI=2.*R4PI	WR40 143
	UPX=R4PI*(E14/HT2-SA*F14)	WR40 144
	VPX=R4PI*G14	WR40 145
	WPM=R4PI*(F14+SA*E14)	WR40 146
	RETURN	WR40 147
200	WRITE (6,210)	WR40 148
	STOP	WR40 149
210	FORMAT (1H0,43HERROR = BODY PANEL SLOPE EXCEEDS MACH ANGLE)	WR40 150
	END	WR40 151

	SUBROUTINE VELCMP	WR41 1
CDC	OVERLAY (LWB,2,0)	WR41 2
CDC	PROGRAM VELCMP	WR41 3
C		WR41 4
C	COMPUTE THE VELOCITY COMPONENTS (U,V,W) AT THE PANEL CONTROL	WR41 5
C	POINTS AND FORM THE AERODYNAMIC INFLUENCE COEFFICIENT MATRICES	WR41 6
C		WR41 7
C	TAPE USAGE IN VELCMP=	WR41 8
C	TAPES: READ AMACH,ALPHA,PHIR	WR41 9
C		WR41 10
C	TAPF7: VELCMP, RE=IND	WR41 11
C	READ ARRAY - CALCULATE BODY INDUCED VELOCITIES	WR41 12
C	WRITE D - DIAGONAL BLOCKS, N GT NMAX	WR41 13
C	RE=IND	WR41 14

C	TAPE8:	VELCMP,	REWIND	WR41	15
C		ROOVEL,	WRITE ON,VR,VB = COMPONENT VELOCITY MATRICES	WR41	16
C		VELCMP,	REWIND	WR41	17
C				WR41	18
C	TAPE9:	VELCMP,	REWIND	WR41	19
C		ROOVEL,	WRITE AN = NORMAL VELOCITY MATRIX	WR41	20
C		VELCMP,	REWIND	WR41	21
C				WR41	22
C	TAPE10:	VELCMP,	REWIND	WR41	23
C		ROOVEL,	WRITE ON = DIAGONAL BLOCKS, N GT NMAX	WR41	24
C		VELCMP,	REWIND	WR41	25
C			READ 0 = COPY TO TAPE7	WR41	26
C			REWIND	WR41	27
C				WR41	28
C	TAPE11:	NOT USED BY BODY VERSION		WR41	29
C				WR41	30
C	COMMON /JOPTNS/	IZI(63),NACPT,IPLOT(4),IPRT(5),IXZSYN		WR41	31
C	COMMON /PARAM /	NBODY,NWING,NTAIL,LHC,THK,XMACH,ALPHA,BETA,ALPHAC		WR41	32
C	1	,PHIR,REFA,REFB,REFC,REFD,REFL,REFX,REFZ		WR41	33
C	COMMON /VELCOM/	NPOINT,NPART,IMAX,JMAX,NMAX,EM,IPRINT,NWTHK		WR41	34
C	1	,NABLOCK,NBROK(20),NBBLOCK,NBROK(30)		WR41	35
C	COMMON /NEWCOM/K1,	KWAF,KWAFOR,KRADX(4),KFORX(4),KFUS,MAX,K4,K5		WR41	36
C	1	,KF(6),KAN(6),KFINDR(6),KANOR(6),KOL,NCPT,LOCPT(20),XCPT(20)		WR41	37
C	COMMON	BLOCK(7500)		WR41	38
C	COMMON /POINT /	ARRAY(6000)		WR41	39
C	COMMON /SEG /	NSEG,NBOW(20),NCOL(20),COSS(20),SINS(20)		WR41	40
C	1	,BTE(20),HWT(20),SPNW(20),XLEW(20),BLEW(20),ZLEW(20),ZB(60)		WR41	41
C	COMMON /MATCOM/	MATIN		WR41	42
C				WR41	43
C	DIMENSION	XLE(600),XPT(600),DEL(600),COSTH(600),XRT(600),YRT(600),		WR41	44
C	1	ZRT(600),YPT(600),ZPT(600),CHORD(600),OZTOX(600),IT(600),		WR41	45
C	2	O(60,60),DELTA(600),DELTI(600)		WR41	46
C				WR41	47
C	EQUIVALENCE	(DEL(1),BLOCK(1))		WR41	48
C	1	, (COSTH(1),BLOCK(601)),	(XRT(1),BLOCK(3901))	WR41	49
C	2	, (YRT(1),BLOCK(4501)),	(ZRT(1),BLOCK(5101))	WR41	50
C	3	, (IT(1),BLOCK(5701)),	(CHORD(1),BLOCK(6301))	WR41	51
C	4	, (OZTOX(1),BLOCK(6901))		WR41	52
C	5	, (XPT(1),ARRAY(1)),	(YPT(1),ARRAY(601))	WR41	53
C	6	, (ZPT(1),ARRAY(1201)),	(O(1),ARRAY(1801))	WR41	54
C	7	, (DELTA(1),ARRAY(2401)),	(DELTI(1),ARRAY(4801))	WR41	55
C	7	, (XLE(1),ARRAY(5401))		WR41	56
C		LOGICAL LRC,SUR		WR41	57
C				WR41	58
C	MATIN=0			WR41	59
C	NMAX=60			WR41	60
CR	EPS=1.E-3			WR41	61
C	CALL CPUTIME(TIME0,DT,1)			WR41	62
C				WR41	63
C	READ IN MACH NUMBER AND ANGLE OF ATTACK			WR41	64
C				WR41	65
C	READ (5,290)	XMACH,ALPHA,PHIR		WR41	66
C		ALPHAC=ALPHA		WR41	67
C	IF (XMACH,LT,0.,OR,XMACH,EQ,EM) RETURN			WR41	68
C	IF (TAHS(IPRINT),GT,1) WRITE(6,500)			WR41	69
C	SUR=XMACH,LT,1.			WR41	70
C	BETAH=SQRT(AHS(XMACH*XMACH-1.))			WR41	71
CR	BETAD=1./BETAH			WR41	72
C	NABLOCK=0			WR41	73
C	NABLOCK=0			WR41	74
C	REWIND 8			WR41	75
C	REWIND 9			WR41	76
C	REWIND 10			WR41	77

NPPOINT=NCPT	WR41 78
NPNEL=NBDY+NWING	WR41 79
IF (NPNEL.EQ.0) RETURN	WR41 80
REWIND 7	WR41 81
NCPT=NWING	WR41 82
CR IF (NWING.EQ.0) GO TO 70	WR41 83
C	WR41 84
C COMPUTE SIZES OF WING DIAGONAL BLOCKS, THEN	WR41 85
C COMPUTE CHORDWISE CONTROL POINT LOCATIONS ON WING	WR41 86
C (PLANAR BOUNDARY CONDITION OPTION ONLY)	WR41 87
C	WR41 88
C ----- INSERT WING BLOCK CODE HERE -----	WR41 89
C	WR41 90
70 ENEXMACH	WR41 91
NPART=1	WR41 92
WRITE (6,310) NPART	WR41 93
WRITE (6,250) NWING,NBDY,NCPT,NSEG	WR41 94
IF (NSEG.EQ.0) GO TO 75	WR41 95
WRITE (6,260) NSEG,(NRROW(N),N=1,NSEG)	WR41 96
WRITE (6,270) NSEG,(NCOL(N),N=1,NSEG)	WR41 97
75 CONTINUE	WR41 98
CR IF (NWING.NE.0) READ (7) ARRAY,CHORD,CZTDX	WR41 99
IF (NBDY.EQ.0) GO TO 100	WR41 100
READ (7) ARRAY	WR41 101
DO 80 N=1,NBDY	WR41 102
XHT(N)=XPT(N)	WR41 103
YHT(N)=YPT(N)	WR41 104
ZHT(N)=ZPT(N)	WR41 105
80 CONTINUE	WR41 106
NPPOINT=NBDY	WR41 107
90 IF (NPART.EQ.1) WRITE (6,320)	WR41 108
C	WR41 109
C COMPUTE VELOCITY COMPONENTS INDUCED BY BODY PANELS	WR41 110
C	WR41 111
CALL BDOVEL	WR41 112
CALL CPUTIME(TIME,DT,1)	WR41 113
WRITE (6,360) TIME,DT,NPART	WR41 114
100 CONTINUE	WR41 115
160 REWIND 8	WR41 116
REWIND 9	WR41 117
REWIND 10	WR41 118
NATIN=1	WR41 119
C	WR41 120
C WRITE DIAGONAL BLOCKS OF AERODYNAMIC MATRIX ON TAPE 7	WR41 121
C	WR41 122
IF (NBDY.EQ.0) GO TO 190	WR41 123
NBBLK=1	WR41 124
NBROW(1)=NBDY	WR41 125
IF (NBDY.LE.NMAX) GO TO 190	WR41 126
NBBLK=0	WR41 127
DO 180 KFU=1,KFUS	WR41 128
NR=KPADX(KFU)+1	WR41 129
NC=KFQDX(KFU)+1	WR41 130
DO 180 NN=1,NC	WR41 131
NBBLK=NBBLOK+1	WR41 132
NBROW(NBBLOK)=NR	WR41 133
DO 170 N=1,NR	WR41 134
READ (10) (D(N,N),N=1,NR)	WR41 135
170 CONTINUE	WR41 136
WRITE (7) D	WR41 137
180 CONTINUE	WR41 138
190 CONTINUE	WR41 139
CR IF (NWING.LE.NMAX.OR.NWING.EQ.0) GO TO 220	WR41 140

09	TRANSFER WING DIAGONAL BLOCKS	NR41	141
220	NWBLOCK=1	NR41	142
	NBROW(1)=NBWING	NR41	143
230	REWIND 7	NR41	144
	REWIND 10	NR41	145
	WRITE (6,280) NWBLOCK,NWBLOCK	NR41	146
	CALL CPUTIM(TIME,DT,1)	NR41	147
	DT=TIME-TIME0	NR41	148
	WRITE(6,370) TIME,DT	NR41	149
	RETURN	NR41	150
250	FORMAT (7H NBWING=,16,2X,6HNBODY=,16,2X,5HNCPT=,16,2X,5HNSG=,16)	NR41	151
260	FORMAT (13H NRQA(N),N=1,,14/(1X,20I6))	NR41	152
270	FORMAT (13H NRQL(N),N=1,,14/(1X,20I6))	NR41	153
280	FORMAT (10X,7HNBLOCK=,16,2X,7HNBLOCK=,16)	NR41	154
290	FORMAT (10F7,0)	NR41	155
300	FORMAT(1H1,10X,38HAERODYNAMIC VELOCITY MATRIX COMPUTATION,	NR41	156
	* 63X,12H** VELCMP **)	NR41	157
310	FORMAT (/// 12H PARTITION =,13)	NR41	158
320	FORMAT (26H INFLUENCE OF BODY ON BODY)	NR41	159
360	FORMAT(/10X,18HEND BODYVEL, TIME=,F10.4,5X,3HDT=,F10.4	NR41	160
	* ,5X,6HNPART=,13)	NR41	161
370	FORMAT(/10X,18HEND VELCMP, TIME=,F10.4,5X,3HDT=,F10.4)	NR41	162
	END	NR41	163

	SUBROUTINE VVELS(NV,VY,ZZ,VX,VY,G,AB,PH,V,W,VRTMAX)	NR42	1
C		NR42	2
C	THIS SUBROUTINE COMPUTES PERTURBATION VELOCITY COMPONENTS DUE TO	NR42	3
C	NV EXTERNAL VORTICES AND THEIR IMAGES INSIDE A BODY WITH	NR42	4
C	ELLIPTICAL CROSS SECTION	NR42	5
C		NR42	6
C		NR42	7
C	DIMENSION VX(1),VY(1),G(1)	NR42	8
C		NR42	9
C	COMMON/COM1/A2,B2,R2	NR42	10
C	COMMON/COM2/SIG2,M2	NR42	11
C		NR42	12
C	COMPLEX TO,VI,DSOT,Z,DSOZ,SI,SIR,SO,TAU,CT,VEL	NR42	13
C		NR42	14
C	EXTERNAL Z,DSOZ	NR42	15
	PI=3.14159265	NR42	16
	TLC=0.001	NR42	17
	CI=CMPLX(0.0,1.0)	NR42	18
	A2=AB*AB	NR42	19
	R2=RR*RR	NR42	20
	APR=AR*RR	NR42	21
	APR2=APR*APR	NR42	22
	R=0.5*APR	NR42	23
	H2=APR2	NR42	24
	R2=R*R	NR42	25
	SIG2=R2	NR42	26
	TO=CMPLX(Y(VY,ZZ)	NR42	27
	SO=Z(TO)	NR42	28
	VI=CMPLX(0.0,0.0)	NR42	29
	DSOT=DSOZ(SO)	NR42	30
C		NR42	31
C	LOOP OVER THE NUMBER OF VORTICES,NV	NR42	32
C		NR42	33

DO 1 I=1,NV	WR42	34
TAU=CMPLX(VX(I),VY(I))	WR42	35
SI=Z(TAU)	WR42	36
SIB=CONJG(SI)	WR42	37
D=CAHS(SI-SIB)	WR42	38
IF(D.LE.TLC) GO TO 2	WR42	39
V1=V1-G(I)/(SD-SI)	WR42	40
2 CONTINUE	WR42	41
D=CAHS(SD-W2/SIB)	WR42	42
IF(D.LE.TLC) GO TO 1	WR42	43
V1=V1+G(I)/(SD-W2/SIB)	WR42	44
1 CONTINUE	WR42	45
C	WR42	46
VEL=0.5*CI*V1*DSDT/PI	WR42	47
V=REAL(VEL)	WR42	48
W=AIMAG(VEL)	WR42	49
AV=ABS(V)	WR42	50
AW=ABS(W)	WR42	51
IF(V.GT.0.0.AND.AV.GE.VRTMAX) V=VRTMAX	WR42	52
IF(W.LT.0.0.AND.AW.GE.VRTMAX) W=-VRTMAX	WR42	53
IF(W.GT.0.0.AND.AW.GE.VRTMAX) W=VRTMAX	WR42	54
IF(W.LT.0.0.AND.AW.GE.VRTMAX) W=-VRTMAX	WR42	55
RETURN	WR42	56
END	WR42	57

COMPLEX FUNCTION Z(CT)	WR43	1
C	WR43	2
C THIS FUNCTION SUBROUTINE CALCULATES THE SIGMA VALUE IN THE	WR43	3
C TRANSFORMED (CIRCLE) PLANE FOR GIVEN TAU IN THE PHYSICAL PLANE	WR43	4
C FOR AN ELLIPTICAL BODY WITH WINGS	WR43	5
C	WR43	6
COMMON/COM2/SIG2,W2	WR43	7
COMMON/COM3/ZR,ZI	WR43	8
COMMON/COM4/G2,G1	WR43	9
COMMON/COM6/W2,W	WR43	10
C	WR43	11
C	WR43	12
C COMPLEX W,G1,G2,CT,W2,CBLU	WR43	13
C	WR43	14
C EXTERNAL DELU	WR43	15
C	WR43	16
Z=DELU(CT)	WR43	17
G1=W+SIG2/W	WR43	18
G2=G1+G1-W2	WR43	19
Y=AIMAG(G2)	WR43	20
AY=1.0	WR43	21
IF(Y.LT.0.0) AY=-1.0	WR43	22
Y/=AIMAG(G1)	WR43	23
AYZ=1.0	WR43	24
IF(YZ.LT.0.0) AYZ=-1.0	WR43	25
G2=CSQRT(G2)*AY*AYZ	WR43	26
IF((ABS(YZ).LE.0.0).AND.(REAL(G1).LT.0.0)) G2=CMPLX(-REAL(G2),	WR43	27
1 AIMAG(G2))	WR43	28
Z=W*(G1+G2)	WR43	29
IF((ABS(ZI).LE.0.0).AND.(ABS(ZR).LE.0.0)) Z=CMPLX(ZR*ABS(REAL(Z)),	WR43	30
1 ZI*ABS(AIMAG(Z)))	WR43	31
RETURN	WR43	32
END	WR43	33

## APPENDIX L

### DESCRIPTION OF PROGRAM VPATH2 AND VPATHL

This appendix is concerned with the description of the vortex chasing programs. They are used to accompany programs DEMON2 and WDYBDY in accordance with the procedures described in section 5 of this report.

Program VPATH2 computes the paths of external vortices along a body with circular cross section with or without cruciform fins attached to it. The configuration can be pitched and rolled. The cruciform fins may have arbitrary deflection angles. Program VPATHL determines the paths of external vortices along a body with elliptical cross section with or without a monoplane wing in the midwing position.

In what follows, the basic theoretical method is described. The geometrical characteristics accounted for in the programs are listed. This is followed by a description of the flow of the programs and program operation. Program limitations and precautions are discussed and the input and output described. Finally program listings are given for programs VPATH2 and VPATHL.

#### Program Description

The vortex chasing scheme implemented in programs VPATH2 and VPATHL makes use of crossflow plane solutions obtained from slender-body theory. Because of the linear nature of the problem it is possible to superimpose different solutions.

Fundamentally, at given axial stations, velocity components are computed in the crossflow plane at the points occupied by a finite set of external vortices in the presence of a wing-body combination. In this calculation, mutual interaction between the vortices, the interaction between the vortices and the wing-body, the effects of included angle of attack and roll, and fin deflection (if applicable) must be included. Once the lateral velocity components are known, the vortex locations at the next axial station downstream can be determined by means of an integration scheme. The vortices move from one axial station to the next in accordance with the flow angle calculated from the lateral velocity components.

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Appendix I contains the crossflow plane solutions for 8 different conditions and/or cross sectional shapes. In both programs, the calculation is started at given axial locations (starting station) with a set of vortices with specified strengths and lateral coordinates. The geometry in the crossflow plane is specified a priori and the programs proceed to integrate in the downstream direction to obtain the vortex paths.

Once the vortex paths are calculated over the length of body or body-wing of interest, the programs can calculate velocity components induced by the set of vortices at specified points. In this process, the vortices are taken to be in the presence of the body only, i.e., the lifting surfaces are not accounted for. This approach serves two purposes. First, for wing-body combinations, the effects of the external vortices with known paths induced in the flow tangency condition can be applied at the control points of the constant u-velocity panels laid out over the wings or fins in program DEMON2, Appendix J. Second, the velocity components induced by the external vortices in the presence of the body only are included in the calculation of pressures on the fins and the body surface. Further discussions are given in sections 3.4 and 4.3 of this report.

### Geometrical Characteristics

This section describes the geometrical characteristics which can be accounted for by the programs. Since the two programs were written for different cross sections, the geometric details of the configurations will be listed separately for each program.

#### Program VPATH2

Body: axisymmetric, constant cross-sectional area

Lifting surfaces: cruciform fins, each fin planar, may have breaks in sweep, each fin can be arbitrarily deflected

#### Program VPATHL

Body: elliptic in cross section, ellipticity constant, may change size of cross section

Lifting surfaces: monoplane wing in midwing position, may have breaks in sweep

## Calculation Procedure

In this section, the sequence of the calculative processes is indicated. The description will be given for both programs simultaneously. Important differences between programs VPATH2 and VPATHL will be pointed out, however.

After reading in the run title, body geometry and wing or fin geometry, the programs proceed to define the side edge of the wing or fin. Flow conditions, the permissible error used in the integration scheme and maximum magnitude of the vortex induced velocity components are then input to both programs. In addition, program VPATH2 reads in the fin deflection angles.

Both programs proceed to read the lateral coordinates of the vortices at the axial station at which they start. The geometrical characteristics of the configuration at hand and flow conditions are written out. Leading- and side-edge vorticity characteristics, if applicable, are then input to both programs. Their influence will be included in the computation of the vortex paths. Program VPATH2 expects this information for 4 fins, program VPATHL expects information for both sides of the monoplane wing.

At the axial station where the vortex path integration is started, program VPATH2 calculates the body radius, the distance from the body centerline to the edge of the lifting surfaces as seen in this crossflow plane. For this and all subsequent axial stations, subroutine SHAPE of program VPATH2 performs this task. For bodies with elliptical cross section (and with constant ellipticity), subroutine SHAPE of program VPATHL computes the horizontal and vertical semiaxes in addition to the distance out to the edge of the monoplane wing as seen in the crossflow plane.

After printing the vortex strengths and the initial vortex coordinates, both programs call on subroutine DASCURU to compute the flow angles at the vortex locations and to determine the vortex locations at the next downstream axial station. To accomplish the former, subroutine DASCURU calls subroutine F. The latter contains calls to subroutines implemented with the various crossflow plane solutions described in Appendix I. The two programs are equipped with different versions of



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subroutine F on account of the different configurations and/or conditions handled.

Consider program VPATH2 first. It treats a cruciform fin-body combination or body alone. Subroutine F in this program first calculates the lateral velocity components at the vortex points due to angle of attack and roll by calling subroutine PITROL. The crossflow plane solution programmed in PITROL is given in Appendix I, section 2. The source term is omitted in that it leads to unbounded potential at infinity. If two opposite fins are symmetrically deflected, subroutine SYMFIN is called from subroutine F to compute an additional contribution to the velocity components at the vortex points. The crossflow plane solution is given in Appendix I, section 3. If only one fin is deflected or if all fins are arbitrarily deflected, subroutine CRUCI is called by subroutine F to calculate the contribution to the velocity components at the vortex points due to this condition. Then, if edge vorticity associated with the lifting surfaces is specified, its contribution to the velocity components at the vortex points is also computed. Subroutine VVELS is used to accomplish this task. The solution implemented in this subroutine is a specialized adaptation of the solution given in Appendix I, section 1. Finally, subroutine F calls subroutine VOTEX to compute the contributions to the velocity components at each vortex point due to the effect of all vortices in the presence of the cruciform fin-body combination. The solution for this sub problem is given in Appendix I, section 1.

The version of subroutine F in program VPATHL treats elliptical cross sections with or without a monoplane wing. The effects of included angle of attack and roll are calculated by a different version of PITROL. The crossflow plane solution is given in Appendix I, section 6. Provision exists to account for a growing body by the use of subroutine EXPAND. The associated solution is given in Appendix I, section 8. Contributions from specified vorticity associated with the monoplane wing edges are calculated with another version of subroutine VVELS. It employs an adaptation of the solution given in Appendix I, section 5. Finally, the contributory effects due to all vortices, in the presence of the monoplane wing-body, at each vortex location is computed by a call to a different version of subroutine VOTEX. The crossflow plane solution implemented in

it is described in Appendix I, section 5. The solutions given in sections 5 and 7 in Appendix I only differ by angles of pitch and sideslip effects.

With the lateral velocities determined by subroutine F at each vortex location and passed back to subroutine DASCUR, the vortices are moved to the next axial station in accordance with the flow angle calculated from the velocity components. The velocity calculation process is repeated and the vortices moved to the next axial station in the downstream direction. This process is repeated until the last axial station, specified in the input, is reached.

Both programs can proceed with the calculation of velocity components in the crossflow plane induced by the vortices at specified points. As mentioned earlier in this appendix, for the purpose of inclusion in the wing boundary condition implemented in program DEMON2, the vortices are considered to be in the presence of the body only.

#### Program Operation

Programs VPATH2 and VPATHL are written in the FORTRAN IV language (029 punch) and has been run on the CDC 6600 machine belonging to Boeing Computer Services, Inc. Core requirement is about 60K octal words.

In addition to the standard input (TAPE5) and output (TAPE6) tapes, the program may require additional devices such as disc files or tapes for reading or storing data sets generated when certain options are used. TAPE4 and TAPE7 are used for this purpose. One data set would consist of a set of control-point coordinates and the other would contain a set of perturbation velocities. It should also be noted that these programs contain complex variables.

Running time required by both programs is a function of the length over which the vortex paths are to be calculated and the permissible error E5 specified in the input. As an example, with E5 equal to 0.0001, running time should not exceed 5 seconds for a pitched and rolled configuration with about 8 external vortices including the computation of vortex induced velocity components at 268 field points.

As an aid in debugging and quick visual inspection, both programs are equipped with a simplified plotting capability. They should only be used with few vortices and over a short running length.

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### Program Limitations and Precautions

There are certain limitations associated with the dimension statements programmed in the vortex tracking programs VPATH2 and VPATHL. The number of vortices to be tracked should not exceed 30. One fin of a cruciform fin configuration or one half of a monoplane wing must be described by a maximum of 7 points in planform. This poses a limitation on the number of allowable breaks in sweep. Some care must be exercised in the choice of the permissible error, E5. If its value is orders of magnitude smaller than  $10^{-4}$ , computation time may become unduly long. The number of stations at which the vortex coordinates are printed in the output cannot exceed 50.

Subroutine DASCURU adjusts the integration interval in accordance with the permissible error E5. If for some reason it cannot satisfy the built in criteria for deciding whether or not given stepsize is accurate enough, DASCURU will stop reducing the stepsize after 32 attempts. The program will then stop and register STOP40. A faulty crossflow plane flow field can cause this problem. At times, the problem can be alleviated by reducing the difference between the first and second stations XIP (see input section).

At the present time, program VPATHL is limited to elliptical cross sections with constant ellipticity. Program VPATH2 cannot handle expanding or contracting axisymmetric cross sections.

Both programs may suffer from slight numerical errors when the running length is very long. It is suspected to be caused by errors introduced by the integration scheme in subroutine DASCURU. This behavior can be observed when chasing a set of vortices, initially symmetrically located relative to the free stream vector in the cross flow plane, along an axisymmetric body of considerable length (15 radii long).

A further limitation occurs when a vortex comes very close to the leading edge of a lifting surface. The computer program will tend to move the vortex away from the lifting surface, or it may move along the contour in an unrealistic fashion. This constitutes a limit to the theory used in the programs. In reality, a vortex is made up of a cloud of small vortices with cores in which the lateral velocity components go to zero towards the center. In any event, such a vortex cloud passes right over

(and under) the lifting surface in question. It is recommended in such a case to forego the vortex chasing calculation and to assume that the vortex moves back parallel to the body centerline.

### Description of Input

This section contains a description of the input for programs VPATH2 and VPATHL. There are some differences in the input on account of the differences in the configurations treated by each program. The input for program VPATH2 will be described first. Then, the description of the input for program VPATHL follows with references made to items of the input for program VPATH2. Listings of all input variables are given at the end of the respective input descriptions.

#### Input for program VPATH2

##### Item 1

The first card serves as identification and may contain any alphanumeric information desired. This information is printed on the first page of the output.

##### Item 2

The second card contains indices concerning the body and lifting-surface geometry, control indices governing the number of axial stations at which information is to be printed, reading in control-point coordinates, writing velocity components, amount of output, and the option to print plots in the program generated output.

##### Item 3

This card contains the endpoints for each body section for which coefficients describing a meridian will be given (Item 4). Usually, only one endpoint is required; that is, one body section will be considered.

##### Item 4

For each body section, a set of coefficients (7 maximum) are specified on this card. They are members of the polynomial shown below and programmed in subroutine SHAPE.

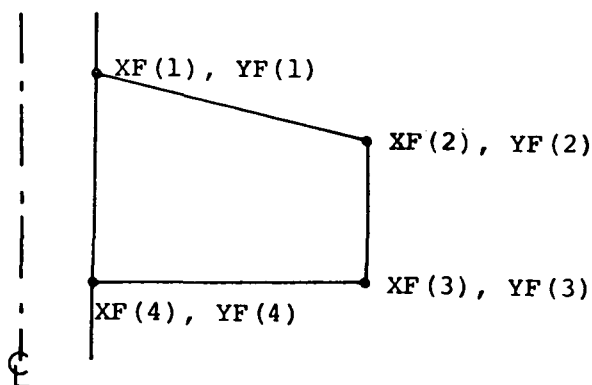
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$$\frac{r}{\ell} = c_1 + c_7 \sqrt{c_2 \left(\frac{x}{\ell}\right)^2 + c_3 \left(\frac{x}{\ell}\right) + c_4} + c_5 \left(\frac{x}{\ell}\right) + c_6 \left(\frac{x}{\ell}\right)^2 \quad (L1)$$

where  $c_1$  through  $c_7$  are the coefficients,  $r$  is the local body radius, and  $\ell$  is the body length. The body length  $\ell$  equals the difference of the endpoints specified in item 3.

### Item 5

The coordinates of the fin planform outline corner points are read in if a fin or wing is present. Only one fin or one wing half needs to be described. The XF and YF coordinates are shown in the example shown below; XF is measured from the body nose and YF is measured from the body



centerline. Note: the axial coordinate of the trailing edge of the rootchord must be made to be slightly larger than the axial coordinate of the trailing edge of the side edge.

### Item 6

Flow conditions and fin deflection angles, if applicable, are specified on this card. In addition, the permissible error, E5, used as a criterion in the integration scheme programmed in subroutine DASCUR is read in. Note: E5 must not be taken too small or the running time required may become unduly large. This card also reads in the upper bound, VRTMAX, imposed on the magnitude of the vortex induced velocity components.

Item 7

The number of vortices at the axial stations to be specified in item 9 are read in by this card. This arrangement allows for the introduction of additional vortices. This information must be supplied for increasing axial location ( $x_B$ -station).

Item 8

The starting coordinates, in the crossflow plane with  $y_B$  to the right and  $z_B$  upwards (i.e. the body coordinate system shown in figure 1), and strengths of the vortices are read in by these cards. If additional vortices are to be accounted for, the starting coordinates and strengths are read in at this time also. This information must be supplied for increasing axial location in synchronization with the number of vortices of item 7 and the axial station of item 9. Note that coordinates  $VX(=y_B)$  and  $VY(=z_B)$  are dimensional.

Item 9

These cards contain the axial stations at which the program will print vortex coordinates. Also, these stations are chosen such that they coincide with the introduction of additional vortices, if applicable, see items 7 and 8.

Item 10

This and the next three items read in specifications describing leading- and side-edge vorticity characteristics. They are obtained from the results calculated by program DEMON2 described in Appendix J of this report. This card contains the number of stations in the spanwise direction at which leading-edge vorticity locations and strengths are to be specified. This information must be supplied for all 4 fins of a cruciform configuration.

Item 11

If the information of item 10 is read in as nonzero, the locations along the leading edge and the strength of the leading-edge vorticity are read in. Note that the dimensional quantity XLE is measured in the wing coordinate system, as calculated by program DEMON2, not the body coordinate system. This information must be supplied for all fins.

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### Item 14

This optional input is specified when NCPIN of item 2 is read in as zero. The number NCP is the number of field points at which vortex induced velocity components are to be computed on the basis of the vortices being in the presence of the body only.

### Item 15

If the information of item 14 is nonzero, these cards contain the coordinates, in the body coordinate system, of the fieldpoints at which vortex induced effects are to be computed. Note: in connection with the use of programs VPATH2 and VPATHL together with program DEMON2, index NCPIN is set equal to 1 and the information of items 14 and 15 is read in by means of a data set stored on TAPE4.

#### INPUT VARIABLES FOR PROGRAM VPATH2 (Circular Cross Section Bodies With Cruciform Fins)

PROGRAM VARIABLE	ALGEBRAIC SYMBOL (IF APPLICABLE)	COMMENTS
<u>Item 1</u>	(20A4)	Any alphanumeric information to identify the run.
<u>Item 2</u>	(8I10)	
NS		Number of body sections for which coefficients $C(I,J)$ are required, $1 \leq NS \leq 7$ .
NF		Number of corner points used to define fin geometry, $1 \leq NF \leq 7$ .
NIP		Number of axial stations to be printed in output; $1 \leq NIP \leq 50$ .
NCPIN		NCPIN = 1 Read in control point and body pressure points from data set (TAPE4). NCPIN = 0 No input.
NVLOUT		NVLOUT = 1 Write velocities induced by moving vortices (and calculated in this program) on data set (TAPE7). NVLOUT = 0 No input.

<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
NOUT		NOUT = 1 Print additional output. NOUT = 0 Minimum output.
IPLT		IPLT = 0 No plots showing vortex positions in the output. IPLT = 1 Vortex positions shown in crossflow planes.
<u>Item 3</u>	(7F10.5)	
XE(I)	$x_{B,i}$	Axial coordinate of the end of each body section, $1 \leq I \leq NS$ .
<u>Item 4</u>	(7F10.5)	
C(I,J)	$C_{ij}$	Coefficients in the body meridian equation, $1 \leq I \leq NS$ , $1 \leq J \leq 7$ .
<u>Item 5</u>	(8F10.5)	
XF(I)	$x_{B,i}$	Optional input concerning fin planform geometry when $NF \neq 0$ . Axial coordinate of fin corner point, $1 \leq I \leq NF$ .
YF(I)	$y_{B,i}$	Lateral coordinate of fin corner point, $1 \leq I \leq NF$ .
<u>Item 6</u>	(8F10.5)	
ALFAC	$\alpha_c$	Included angle of attack, measured between free-stream velocity vector and body centerline.
PHI	$\phi$	Angle of roll, positive right fin down.
D1	$\delta_1$	Deflection angle of upper vertical fin, positive: trailing edges to right, degrees.
D2	$\delta_2$	Deflection angle of right horizontal fin, positive: trailing edge down, degrees.
D3	$\delta_3$	Deflection angle of lower vertical fin, positive: trailing edge to right, degrees.
D4	$\delta_4$	Deflection angle of left horizontal fin, positive: trailing edge down, degrees.



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PROGRAM VARIABLE	ALGEBRAIC SYMBOL (IF APPLICABLE)	COMMENTS
E5		Error allowed in integration subroutine DASCUR. Use the value 0.0001 or less.
VRTMAX		Maximum magnitude of vortex induced velocities, use the value 0.35.
<u>Item 7</u>	(16I5)	
NVV(I)		Total number of vortices at each axial station, $1 \leq I \leq NIP$ , $NVMAX = NVV(NIP)$ .
<u>Item 8</u>	(6F10.5)	Starting coordinates of the vortices.
VX(I)	$y_B$	$y_B$ -coordinate of vortex I.
VY(I)	$z_B$	$z_B$ -coordinate of vortex I.
G(I)	$\frac{\Gamma_V}{V_\infty}$	Vortex strength, counterclockwise positive (when viewing forward), $1 \leq I \leq NVMAX$ , $NVMAX = NVV(NIP)$ .
<u>Item 9</u>	(8F10.5)	
XIP(I)	$x_{B,i}$	Axial station at which output is required, $1 \leq I \leq NIP$ .
<u>Item 10</u>	(8I10)	
MSWR		Number of leading-edge vortex information stations for right horizontal fin.
MSWL		Number of leading-edge vortex information stations for the left horizontal fin.
MSWU		Number of leading-edge vortex information stations for the upper vertical fin.
MSWD		Number of leading-edge vortex information stations for the lower vertical fin.
		$NEDGV = MSWR + MSWL + MSWU + MSWD$ .
<u>Item 11</u>	(6F10.5)	Optional input when $NEDGV \neq 0$ .
XLE(JLE)	$x_{w,LE}$	Wing x-coordinate of station on fin leading edge.

<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
CGLOC(JLE)	$\bar{y}_{LE}, \bar{z}_{LE}$	Center of gravity of the leading-edge vorticity distribution at $x_{w,LE}$ .
GAMLE(JLE)	$\frac{\Gamma_{LE}}{V_{\infty}}$	Strength of the vorticity distribution at XLE(JLE).  $1 \leq JLE \leq NEDGV.$
<u>Item 12</u>	(I10)	
NCW		Number of side-edge vortex information stations. Same for all fins. NSIDGE = 4 (NCW).
<u>Item 13</u>	(6F10.5)	Optional input when NSIDGE $\neq$ 0.
XSE(JSE)	$x_{w,SE}$	Wing x-coordinate of station on fin side edge
CGSELC(JSE)	$\bar{y}_{SE}, \bar{z}_{SE}$	Center of gravity of side-edge vorticity distribution at $x_{w,SE}$ .
GAMSE(JSE)	$\frac{\Gamma_{SE}}{V_{\infty}}$	Strength of vorticity distribution at XSE(JSE).  $1 \leq JSE \leq NSIDGE.$
<u>Item 14</u>	(I10)	Next two items are optional input for NCPIN=0, only.
NCP		Number of control points and body pressure points or field points at which vortex induced velocities are to be calculated.
<u>Item 15</u>	(3F10.5)	Optional input when NCP $\neq$ 0 specifying field point coordinates.
CPX	$x_B$	Body x-coordinate of field point.
CPY	$y_B$	Body y-coordinate of field point.
CPZ	$z_B$	Body z-coordinate of field point.

## APPENDIX L

Input for program VPATHL

### Item 1

Refer to input item 1 under program VPATH2.

### Item 2

Refer to input item 2 under program VPATH2. Only difference is option to set optional output plot size. The bounds read in as item 4 below.

### Item 3

This card specifies the inverse of the ellipticity ratio of the elliptical cross section under consideration. This ratio is a constant for all axial locations.

### Item 4

Refer to input item 3 under program VPATH2.

### Item 5

Refer to input item 4 under program VPATH2. The polynomial is used to describe the meridian associated with the horizontal semiaxis of an elliptical cross section.

### Item 6

Refer to input item 5 under program VPATHL.

### Item 7

If IPLT equals 1 in item 2, the maximum and minimum values of the lateral coordinates are read in by this card. Now, XMAX and XMIN pertain to  $y_B$  coordinate and YMAX and YMIN pertain to  $z_B$  coordinate of the body coordinate system, see figure 1.

### Item 8

Refer to input item 6 under program VPATH2. Omit deflection angles.

### Item 9

Refer to item 7 under program VPATH2.

Item 10

Refer to item 8 under program VPATH2.

Item 11

Refer to item 9 under program VPATH2.

Item 12

Refer to item 10 under program VPATH2. Only MSWR and MSWL need be specified since the lifting surface is a monoplane wing designated as right and left "fins".

Item 13

Refer to item 11 under program VPATH2. Here, leading-edge vorticity characteristics need only be specified for the right and left "fins".

Item 14

Refer to item 12 under program VPATH2. Here NSIDGE = 2 NCW.

Item 15

Refer to item 13 under program VPATH2. In this instance, this information is only specified for the side edges of the right and left "fins".

Item 16

Refer to item 14 under program VPATH2.

Item 17

Refer to item 15 under program VPATH2.

INPUT VARIABLES FOR PROGRAM VPATHL  
(Elliptical Cross Section Bodies With Monoplane Wing)

<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
Item 1	(20A4)	Any alphanumeric information to identify the run.

# APPENDIX L

<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
<u>Item 2</u>	(8I10)	
NS		Number of body sections for which coefficients $C(I,J)$ are required, $1 \leq NS \leq 7$ .
NF		Number of corner points used to define fin geometry, $1 \leq NF \leq 7$ .
NIP		Number of axial stations to be printed in output, $1 \leq NIP \leq 50$ .
NCPIN		NCPIN = 1 Read in control point and body pressure points from data set (TAPE4).  NCPIN = 0 No input.
NVLOUT		NVLOUT = 1 Write velocities induced by moving vortices (and calculated in this program) on data set (TAPE7).  NVLOUT = 0 No output on data set.
NOUT		NOUT = 0 Minimum output.  NOUT = 1 Some additional debug output.  NOUT = 2,3 Large amount of debug output containing information about intermediate complex variables. (use only when NIP = 2)
IPLT		IPLT = 0 No plots showing vortex positions in the output.  IPLT = 1 Specify maximum and minimum x and y to be used in the plots, also see Item 4.  IPLT = 3 Program determines plot size.
<u>Item 3</u>	(F10.5)	
BFACT	$1/\epsilon$	Ratio of vertical semiaxis over horizontal semiaxis.
<u>Item 4</u>	(7F10.5)	
XE(I)	$x_{B,i}$	Axial coordinate of the end of each body section, $1 \leq I \leq NS$ .

<u>PROGRAM VARIABLE</u>	<u>ALGEBRAIC SYMBOL (IF APPLICABLE)</u>	<u>COMMENTS</u>
<u>Item 5</u>	(7F10.5)	
C(I,J)	$C_{ij}$	Coefficients in the body meridian equation, $1 \leq I \leq NS, 1 \leq J \leq 7$ .
<u>Item 6</u>	(8F10.5)	
		Optional input concerning fin planform geometry when $NF \neq 0$ .
XF(I)	$x_{B,i}$	Axial coordinate of fin corner point, $1 \leq I \leq NF$ .
YF(I)	$y_{B,i}$	Lateral coordinate of fin corner point, $1 \leq I \leq NF$ .
<u>Item 7</u>	(8F10.5)	
		Optional input required when $IPLT = 1$ in Item 2.
XMAX		Maximum x-value used in program generated plots in output.
XMIN		Minimum x-value used in program generated plots in output.
YMAX		Maximum y-value used in program generated plots in output.
YMIN		Minimum y-value used in program generated plots in output.
<u>Item 8</u>	(8F10.5)	
ALFAC	$\alpha_c$	Included angle of attack, measured between free-stream velocity vector and body centerline.
PHI	$\phi$	Angle of roll, positive right fin down.
E5		Error allowed in integration subroutine DASCRU. Use the value 0.0001 or less.
VRTMAX		Maximum magnitude of vortex induced velocities, if $VRTMAX = 0$ , the value 0.35 is used.
<u>Item 9</u>	(16I5)	
NVV(I)		Total number of vortices at each axial station, $1 \leq I \leq NIP, NVMAX = NVV(NIP)$ .

# APPENDIX L

PROGRAM VARIABLE	ALGEBRAIC SYMBOL (IF APPLICABLE)	COMMENTS
<u>Item 10</u>	(6F10.5)	Initial vortex positions in crossflow plane.
VX(I)	$y_{B,i}$	$y_B$ -coordinate of vortex I.
VY(I)	$z_{B,i}$	$z_B$ -coordinate of vortex I.
G(I)	$\frac{\Gamma_{V,i}}{V_\infty}$	Vortex strength, counterclockwise positive (when viewing forward), $1 \leq I \leq NVMAX$ , $NVMAX = NVV(NIP)$ .
<u>Item 11</u>	(8F10.5)	
XIP(I)	$x_{B,i}$	Axial station at which output is required, $1 \leq I \leq NIP$ .
<u>Item 12</u>	(8I10)	
MSWR		Number of leading-edge vortex information stations for right horizontal fin.
MSWL		Number of leading-edge vortex information stations for the left horizontal fin.
		$NEDGV = MSWR + MSWL$
<u>Item 13</u>	(6F10.5)	Optional input when $NEDGV \neq 0$ .
XLE(JLE)	$x_{w,LE}$	Wing x-coordinate of station on fin leading edge.
CGLOC(JLE)	$\bar{y}_{LE}, \bar{z}_{LE}$	Center of gravity of the leading-edge vorticity distribution at $x_{w,LE}$ .
GAMLE(JLE)	$\frac{\Gamma_{LE}}{V_\infty}$	Strength of the vorticity distribution at XLE(JLE).  $1 \leq JLE \leq NEDGV$
<u>Item 14</u>	(I10)	
NCW		Number of side-edge vortex information stations. Same for all fins. $NSIDGE = 2$ (NCW).

PROGRAM VARIABLE	ALGEBRAIC SYMBOL (IF APPLICABLE)	COMMENTS
<u>Item 15</u>	(6F10.5)	Optional input when NSIDGE $\neq$ 0.
XSE(JSE)	$x_{w,SE}$	Wing x-coordinate of station on fin side edge.
CGSELC(JSE)	$\bar{y}_{SE}, \bar{z}_{SE}$	Center of gravity of side-edge vorticity distribution at $x_{w,SE}$ .
GAMSE(JSE)	$\frac{\Gamma_{SE}}{V_{\infty}}$	Strength of vorticity distribution at XSE(JSE). $1 \leq JSE \leq NSIDGE$
<u>Item 16</u>	(I10)	Next two items are optional input for NCPIN = 0, only.
NCP		Number of control points and body pressure points or field points at which vortex induced velocities are to be calculated.
<u>Item 17</u>	(3F10.5)	Optional input when NCP $\neq$ 0 specifying field point coordinates.
CPX	$x_B$	Body x-coordinate of field point.
CPY	$y_B$	Body y-coordinate of field point.
CPZ	$z_B$	Body z-coordinate of field point.

#### Description of Output

This section describes the output generated by programs VPATH2 and VPATHL. Only a few items in the output of these programs are different as pointed out below. The output to be described is generated when print control index NOUT is set equal to zero. For nonzero values, large amounts of additional output results. Thus, other than for debugging purposes, index NOUT must be set equal to zero in item 2 of the input for both programs. The results of the output plot options are self evident and will not be discussed here.

The first page of output contains the run identification and the geometry of the fin or wing planform. Included angle of attack and roll



## APPENDIX L

are printed. Program VPATH2 also gives the deflection angles of the fins, if applicable. The permissible error in the integration scheme is specified. This output is followed by a list of vortex coordinates in the crossflow plane as a function of increasing axial location. Quantity  $Y, VRTX$  is  $y_B$  and  $Z, VRTX$  is  $z_B$ , both in the body coordinate system, refer to figure 1. The vortex strengths divided by the free-stream velocity,  $GAMMA/VINF$ , are also indicated. This information is given for each of the output stations,  $XIP$ , specified in the input and printed as  $X$ . At each station, the local body geometry and semispan (distance from body centerline to edge of fin or wing as seen in the crossflow plane) are written. Program VPATH2 gives the local body radius for the axisymmetric body. Program VPATHL specifies the local horizontal semiaxis and the vertical semiaxis.

The final item in the output of both programs are the coordinates of field points (or control points), read in by means of input or data set, and the velocity components induced by the vortices at the points. The coordinates and the velocity components are given in the body coordinate system, refer to figure 1. The vortex effects are calculated on the basis of the vortices in the presence of the body only.

### Program Listings

Programs VPATH2 and VPATHL are written in FORTRAN IV (029 punch) computer language for the CDC 6600 computer. Program VPATH2 consists of a main routine, VPATH, and 12 subroutines. Program VPATHL consists of a main routine, VPATHL, and 13 subroutines. The listings are shown on the indicated pages with the main program first and the subroutines following in alphabetical order.

## PROGRAM VPATH2

	<u>ROUTINE</u>	<u>IDENTIFICATION</u> Cols. 73-77	<u>PAGE NO.</u>
1.	VPATH	VPC01	413
2.	CRUCI	02	419
3.	DASCRU	03	420
4.	F	04	423
5.	FCT	05	426
6.	PITROL	06	427
7.	PLOTVB	07	427
8.	SHAPE	08	430
9.	SIMP	09	431
10.	SYMFIN	10	431
11.	VOTEX	11	432
12.	VVELS	12	433
13.	Z	13	434

## PROGRAM VPATH2

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C      PROGRAM VPATH(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE4,TAPE7)  VPC01  1
C      VERSION: VPATH2  VPC01  2
C      VPC01  3
C      VPC01  4
C      THIS PROGRAM COMPUTES THE PATHS AND VORTEX INDUCED CROSSFLOW  VPC01  5
C      VELOCITIES AT SPECIFIED FIELD POINTS FOR A SET OF VORTICES IN THE  VPC01  6
C      PRESENCE OF A WING-BODY COMBINATION AT ANGLE OF ATTACK AND ROLL, AND  VPC01  7
C      OR ALL OF THE FINS MAY BE DEFLECTED. SLENDER BODY THEORY IS USED  VPC01  8
C      IN THE COMPUTATION OF THE CROSSFLOW VELOCITIES.  VPC01  9
C      VPC01 10
C      VPC01 11
C      THE COORDINATE SYSTEM USED HERE IS THE BODY COORDINATE SYSTEM  VPC01 12
C      WITH THE X-AXIS ALONG THE BODY CENTER-LINE STARTING AT THE NOSE TIP,  VPC01 13
C      Y-AXIS TO THE RIGHT WHEN LOOKING FORWARD,Z-AXIS UP.  VPC01 14
C      VPC01 15
C      WHEN FINS ARE PRESENT,THE Y-AXIS FALLS ALONG RIGHT FIN,  VPC01 16
C      THE Z-AXIS ALONG THE UPPER FIN.  THUS,THIS PROGRAM PERFORMS ALL  VPC01 17
C      VORTEX PATH CALCULATIONS IN A ROLLED COORDINATE SYSTEM.  VPC01 18
C      VPC01 19
C      *****NOTE: CRUCIFORM FINS ONLY*****  VPC01 20
C      VPC01 21
C      VPC01 22
C      DIMENSION TITLE(20),XD(60),XIP(50),XK(120)  VPC01 23
C      DIMENSION VXP(30,30,2),VYV(30)  VPC01 24
C      VPC01 25
C      COMMON/VFL/AL,HE,G1,G2,G3,G4,VX(30),VY(30),G(30),AV,NDEL,MS,F,  VPC01 26
C      LXE(7),XE(7),YE(7),GL(7),IFIN  VPC01 27
C      COMMON/RLK2/AC,RHI  VPC01 28
C      COMMON/FTNLE/ZLF(40),CGLUC(60),GAMLE(40),MSWR,MSWL,MSH,MSD,  VPC01 29
C      INEDGY,XTITLE  VPC01 30
C      COMMON/STDEG/XSF(40),CGSEL(40),GAMSE(40),NCW,NSIGLE,XTITF  VPC01 31
C      COMMON/XPLT(30,52),YPLT(30,52),ZPLT(30,52),WPLT(52),ROT(3)  VPC01 32
C      * ,XPR(17,18),YPR(17,18)  VPC01 33
C      VPC01 34
C      NAMELIST/DEBUG/MS,HE,NIP,ACFIN,VALOUT,ROUT,VRTXAX,XF,C,XF,YF,AVV  VPC01 35
C      VPC01 36
C      1 FORMAT(20A4)  VPC01 37
C      0 FORMAT(A10)  VPC01 38
C      5 FORMAT(7F10,5)  VPC01 39
C      6 FORMAT(8F10,5)  VPC01 40
C      7 FORMAT(8F10,5)  VPC01 41
C      9 FORMAT (/5X,20HLOCAL BODY RADIUS = ,F10,5,5X,  VPC01 42
C      1 20HLOCAL SEMT SPAN S = ,F10,5/)  VPC01 43
C      11 FORMAT (/5X,33H INCLUDED ANGLE OF ATTACK(DEG) = ,F10,5,  VPC01 44
C      1 20H ROLL ANGLE(DEG) = ,F10,5/)  VPC01 45
C      12 FORMAT (2X,24H PANEL DEFL.(DEG) 1,/,/9X,9H DELTA1= ,F6,3,  VPC01 46
C      1 11H DELTA2= ,F6,3,11H DELTA3= ,F6,3,11H DELTA4= ,F6,3//)  VPC01 47
C      21 FORMAT(/19H X-STATION NO.,(3,9H X=,F6,3,9X,  VPC01 48
C      1 25H INTEGRATION STEP SIZE = ,F10,5//)  VPC01 49
C      22 FORMAT(115,4X,2E17,5,F15,5)  VPC01 50
C      25 FORMAT (///16X,36HVORTEX COORDINATES IN CROSS-FLOW PLANE,/)  VPC01 51
C      26 FORMAT (/43H INITIAL VORTEX POSITIONS AT X = ,F6,3/)  VPC01 52
C      27 FORMAT (10X,7H VORTEX,10X,7H Y,VPTX,10X,7H Z,VPTX,6X,  VPC01 53
C      1 10HGAUSS/VITF/)  VPC01 54
C      30 FORMAT(16I5)  VPC01 55
C      31 FORMAT(/// 6X,76HCROSSFLOW VELOCITIES AT CTRL PTNS INDUCED BY  VPC01 56
C      1 VORTICES AND THEIR IMAGES,/)  VPC01 57
C      1 5X,2E10,10X,6X,BODY,10X,6XZ,BODY,10X,1HV,15X,1H*)  VPC01 58
C      32 FORMAT(4X,15,6X,5E15,5)  VPC01 59
C      50 FORMAT(3F10,5)  VPC01 60
C      700 FORMAT (/5(1H*), 59HPERMISSIBLE RELATIVE ERROR,ES,USED IN INTEG  VPC01 61
C      1TION SCHEME = ,E12,5/)  VPC01 62
C      701 FORMAT (///5(1H*),61HROUTINE BASCPU CAN NOT OBTAIN VALUE FOR I  VPC01 63

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VPC001126

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      IP1=I+1
      IF (YF(I),EQ,YMAX,AND,YF(IP1),EQ,YMAX) GO TO R2
      IF (YF(I),EQ,YMAX) GO TO R3
61  CONTINUE
      GO TO R4
      R2  YMAX=I
          IMAXP=J+1
          XTIPLE=YF(IMAX)
          VTIPLE=YF(IMAX)
          XTIPTE=YF(IMAXP)
          VTIPTE=YF(IMAXP)
          GO TO R4
      R3  XTIPLE=YF(IMAX)
          XTIPTE=XTIPLE
      R4  CONTINUE
C
C
C
C      ALFAC=INCLUDED ANGLE OF ATTACK, PHI=ROLL ANGLE BOTH IN DEGREE
C      D1,D2,D3,D4 ARE FIN DEFLECTIONS IN DEGREES, POSITIVE TRAILING
C      EDGE DOWN FOR HOP, FINS, TRAILING EDGE TO THE RIGHT FOR VERT.
C      FINS
C      E5 = PERMISSIBLE RELATIVE ERROR IN THE PATH INTEGRATION SCHEME
C
      READ(5,6)ALFAC,PHI,D1,D2,D3,D4,E5,VRTMAX
      IF (VRTMAX,EQ,0.0) VRTMAX=0.35
      HT=ARS(D1)+ARS(D2)+ARS(D3)+ARS(D4)
      NOEL=0
      IF (HT,NE,0.0) NOEL=1
C
C .. X-STATIONS, INTEGRATION INFO, + INITIAL VORTEX POSITIONS AND STRENGTH
C
C      NVV = TOTAL NUMBER OF VORTICES AT EACH X-STATION
C
C      READ(5,30)(NVV(I),I=1,NIP)
C      NV=NVV(1)
C      NVMAX=NVV(NIP)
C
C      READ IN CROSSFLOW STARTING COORDINATES AND STRENGTHS FOR ALL
C      VORTICES REGARDLESS OF THE X-STATION AT WHICH THEY START.
C      THIS INFO MUST BE INPUT FOR INCREASING X-STATION.
C
C      HERE....VX(I)..V-COORDINATE
C              VY(I)..Z-COORDINATE
C              G(I)...GAMMA/PI*F, COUNTERCLOCKWISE POSITIVE,
C                   WHEN VIEWING FORWARD.
C
      READ(5,7)(VX(I),VY(I),G(I),I=1,NVMAX)
      DO 8 I=1,NV
      J=2*I-1
      K=J+1
      VXP(1,I,1)=VX(I)
      VXP(1,I,2)=VY(I)
      XP(J)=VX(I)
      A  XP(K)=VY(I)
C
C      XIP= X- VALUES AT THE NIP X-STATIONS AT WHICH OUTPUT REQ.
C      FIRST VALUE FOR XIP CAN BE ANY NUMBER LARGER THAN ZERO
C      INTEGRATION STARTS AT XIP(1)
C      INTEGRATION STEP SIZE DETERMINED BY DASCPU...H
C

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VPC01189

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C      READ(5,6)(XIP(I),I=1,NIP)
C
C      WRITE(6,1)TITLE
C      IF (NF.NE.0)
C      1 WRITE (6,704) VMAX,CMP,XF(1),YF(1),XTIPLE,YTIPLE,XTIPE,YTIPE,
C      1 XF(NF),YF(NF)
C      WRITE(6,11)ALFAC,PHI
C      WRITE(6,12)O1,O2,O3,O4
C      IF (NOUT.NE.0) WRITE (6,DEHUG)
C
C      READ NUMBERS OF FIN LEADING EDGE VORTEX INFO STATIONS XLE FOR
C      EACH FIN.
C      FOR EACH XLE STATION, READ IN YBAR OR ZBAR(=CGLOC) AND STRENGTH
C      OF THE VORTICITY DISTRIBUTION.
C      NOTE: THIS VORTICITY IS FIXED IN POSITION, IT AFFECTS THE FLOWFIELD
C      NOTE: XLE AND YSE ARE READ IN IN THE FIN COORDINATE SYSTEM AND
C      MUST BE TRANSFORMED TO BODY COORDINATE SYSTEM.
C
C      READ (5,4) MSWR,MSWL,MSWD,MSWD
C      NEDGV=MSWR+MSWL+MSWD+MSWD
C      IF (NEDGV.EQ.0) GO TO 19
C      READ (5,7) (XLE(IFV),CGLOC(IFV),GAMLE(IFV),
C      1 IFV=1,NEDGV)
C      WRITE (6,706)
C      DO 15 JLE=1,NEDGV
C      XLE(JLE)=XLE(JLE)+XF(1)
C      15 WRITE (6,705) JLE,XLE(JLE),CGLOC(JLE),GAMLE(JLE)
C      19 CONTINUE
C
C      READ NUMBER OF FIN SIDE EDGE VORTEX INFO STATIONS XSE FOR EACH
C      FIN.
C      NOTE: THIS VORTICITY IS FIXED IN POSITION, IT AFFECTS THE FLOWFIELD
C      FOR EACH XSE STATION, READ IN YBAR OR ZBAR(=CGSELC) AND THE
C      STRENGTH OF THE VORTICITY DISTRIBUTION
C
C      READ (5,4) NSW
C      NSIDGE=NSW+NCW
C      IF (NSIDGE.EQ.0) GO TO 18
C      READ (5,7) (XSE(JSE),CGSELC(JSE),GAMSE(JSE),
C      1 JSE=1,NSIDGE)
C      WRITE (6,707)
C      DO 16 JSE=1,NSIDGE
C      XSE(JSE)=XSE(JSE)+XF(1)
C      16 WRITE (6,705) JSE,XSE(JSE),CGSELC(JSE),GAMSE(JSE)
C      18 CONTINUE
C
C      WRITE (6,700) AS
C      WRITE (6,25)
C      WRITE(6,26)XIP(1)
C      CALL SHAPE (XIP(1),WLOC,SLCC)
C      WRITE (6,91) WLOC,SLCC
C      WRITE(6,27)
C      WRITE(6,22)(L,VX(L),VY(L),G(L),L=1,NV)
C
C      CONVERT ANGLES TO RADIAN
C
C      AC=ALFAC*RAO
C      HA=PHI*RAO
C      PHIE=E

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VPC01214  
VPC01215  
VPC01216  
VPC01217  
VPC01218  
VPC01219  
VPC01220  
VPC01221  
VPC01222  
VPC01223  
VPC01224  
VPC01225  
VPC01226  
VPC01227  
VPC01228  
VPC01229  
VPC01230  
VPC01231  
VPC01232  
VPC01233  
VPC01234  
VPC01235  
VPC01236  
VPC01237  
VPC01238  
VPC01239  
VPC01240  
VPC01241  
VPC01242  
VPC01243  
VPC01244  
VPC01245  
VPC01246  
VPC01247  
VPC01248  
VPC01249  
VPC01250  
VPC01251  
VPC01252

```

Q1=Q1*PI*2
Q2=Q2*PI*2
Q3=Q3*PI*2
Q4=Q4*PI*2
AL=ASIN(SIN(AC)*COS(HE))
RE=ASIN(SIN(AC)*SIN(HE))

```

VPC01253  
VPC01254  
VPC01255  
VPC01256  
VPC01257  
VPC01258  
VPC01259

.....COMPUTE VORTEX PATHS USING DASCRO INTEGRATION SUBROUTINE.....

VPC01260  
VPC01261  
VPC01262  
VPC01263  
VPC01264  
VPC01265  
VPC01266  
VPC01267  
VPC01268  
VPC01269  
VPC01270  
VPC01271

```

NIP=NIP+1
HXP(2)=XIP(1)
DO 20 I=1,NIP
  I1=I+1
  NV=NIV(I)
  NVN=NIV(I1)
  NV1=NIV+1
  K=2*NV
  A1=XIP(I)
  B1=XIP(I+1)

```

VPC01272  
VPC01273  
VPC01274

CALL DASCRO(A1,B1,H,N,XD,K,IER,E5,VRTMAX)

```

IF IER GREATER THAN 32,DASCRO HAD TROUBLE GETTING STEP SIZE.
THEN, RATHER THAN CONTINUING, IF THE INTEGRATION, STOP 40
REDUCE XIP(2)=XIP(1) AND RERUN

```

VPC01275  
VPC01276  
VPC01277

```

IF (IER,GE,32) GO TO 28
GO TO 29
28 WRITE (6,701)
STOP 40
29 CONTINUE

```

VPC01278  
VPC01279  
VPC01280  
VPC01281  
VPC01282  
VPC01283  
VPC01284  
VPC01285

.. ADD THE NEW VORTICES AND THEIR POSITIONS FOR THE NEXT X-INTERVAL

```

IF (NVN,EQ,NVIGN) GO TO 39
DO 35 K1=NV1,NVN
  JL=2*K1-1
  KK=JL+1
  X0(JL)=VX(K1)
35 X0(KK)=VY(K1)
39 CONTINUE

```

VPC01286  
VPC01287  
VPC01288  
VPC01289  
VPC01290  
VPC01291  
VPC01292  
VPC01293  
VPC01294  
VPC01295

.. OUTPUT VORTEX POSITIONS AND CONFIGURATION CHARACTERISTICS AT THIS STATION.

```

WRITE(6,21)I1,B1,H
CALL SHAPE (H1,PLCC,SLCC)
WRITE (6,9) PLCC,SLCC
WRITE(6,27)
DO 23 L=1,NVN
  J=2*L-1
  K=J+1
  VXP(I1,L,1)=X0(J)
  VXP(I1,L,2)=X0(K)
  WRITE(6,22)L,X0(J),X0(K),G(L)

```

VPC01296  
VPC01297  
VPC01298  
VPC01299  
VPC01300

SAVE VORTEX LOCATION FOR PLOT

```

JCV=NIP+L+1
XPLT(I,JCV)=H1
YPLT(I,JCV)=X0(J)
ZPLT(I,JCV)=X0(K)

```

VPC01301  
VPC01302  
VPC01303  
VPC01304  
VPC01305  
VPC01306  
VPC01307  
VPC01308  
VPC01309  
VPC01310  
VPC01311  
VPC01312  
VPC01313  
VPC01314  
VPC01315



23 CONTINUE	VPC01316
C	VPC01317
C SAVE BODY POINTS FOR PLOT	VPC01318
C	VPC01319
XPLT(1,1)=H1	VPC01320
YPLT(1,1)=RLOC	VPC01321
ZPLT(1,1)=RLOC	VPC01322
YPLT(2,1)=SLOC	VPC01323
20 CONTINUE	VPC01324
C	VPC01325
C PLOT VORTEX LOCATIONS	VPC01326
C	VPC01327
XPLT(1,1)=XIP(1)	VPC01328
IF (IPLT.GT.0)	VPC01329
* CALL PLOTVM(XPLT,YPLT,ZPLT,XPLT,NIP1,NVN,30,ROT,XF,YF,NF,XP2,YP2)	VPC01330
C	VPC01331
C.. COMPUTE VELOCITIES AT THE SPECIFIED CONTROL POINTS INDUCED BY MV	VPC01332
C    EXTERNAL VORTICES AND THEIR IMAGES.	VPC01333
C	VPC01334
C	VPC01335
C NOTE: IF CONTROL POINTS ARE PASSED THROUGH BY MEANS OF A DATA SET	VPC01336
C    I.E. WHEN NCPIN IS NOT EQUAL TO 0, INDEX NCP IS READ IN FROM	VPC01337
C    THE DATA SET ALSO.	VPC01338
C NOTE: X=COORDINATE OF CONTROL POINT MUST THEN BE TRANSFORMED TO BODY	VPC01339
C    COORDINATE SYSTEM.	VPC01340
C    THIS IS DONE BELOW.	VPC01341
C	VPC01342
C	VPC01343
NCP=0	VPC01344
IF (NCPIN.NE.0) REWIND 4	VPC01345
IF (NVLOUT.NE.0) REWIND 7	VPC01346
IF (NCPIN.EQ.0) GO TO 72	VPC01347
IF (NCPIN.NE.0) READ (4,745) NCP	VPC01348
IF (END(4).NE.0) GO TO 99	VPC01349
GO TO 73	VPC01350
72 READ (5,4) NCP	VPC01351
73 CONTINUE	VPC01352
IF (NCP.EQ.0) GO TO 99	VPC01353
WRITE(6,31)	VPC01354
DO 69 J=1,NCP	VPC01355
IF (NCPIN.EQ.0) GO TO 70	VPC01356
READ (4,745) IC,CPX,CPY,CPZ	VPC01357
CPX=CPX+XF(1)	VPC01358
GO TO 71	VPC01359
70 READ(5,60)CPX,CPY,CPZ	VPC01360
71 CONTINUE	VPC01361
C	VPC01362
C.. DETERMINE THE X-STATIONS ADJACENT TO THE CONTROL POINT	VPC01363
C	VPC01364
DO 61 I=1,NIP	VPC01365
IF (CPX.LT.XIP(1)) GO TO 69	VPC01366
J=I-1	VPC01367
IF (I.EQ.1) J=1	VPC01368
IF (CPX.LE.XIP(I)) GO TO 62	VPC01369
61 CONTINUE	VPC01370
C	VPC01371
C DETERMINE BY INTERPOLATION THE POSITION IN THE CROSSFLOW PLANE OF ALL	VPC01372
C    VORTICES AT EACH STATION CPX.	VPC01373
C	VPC01374
62 K=J+1	VPC01375
X1=XIP(J)	VPC01376
X2=XIP(K)	VPC01377
* T1=(X2-CPX)/(X2-X1)	VPC01378

	AT2=(CPX-X1)/(X2-X1)	VPC01379
	SV=VVV(J)	VPC01380
	CALL SHAPE (CPX,HB,SL)	VPC01381
	IF (COUNT,EG,0) WRITE (6,703)	VPC01382
	DO 63 J=1,NV	VPC01383
	VX(I)=AT1*VXP(J,1,1)+AT2*VXP(A,1,1)	VPC01384
	VY(I)=AT1*VXP(J,1,2)+AT2*VXP(X,1,2)	VPC01385
	IF (COUNT,EG,0) GO TO 63	VPC01386
	WRITE (6,702) I,VX(I),VY(I)	VPC01387
63	CONTINUE	VPC01388
C		VPC01389
C	SUBROUTINE VVELS CALCULATES VORTEX VELOCITIES INCLUDING EFFECTS	VPC01390
C	FROM IMAGE VORTICES. CENTER VORTEX EFFECTS ARE OMITTED.	VPC01391
C		VPC01392
	CALL VVELS(V,CPY,CPZ,VX,VY,G,HB,V,N,VRTAX)	VPC01393
	WRITE (6,32) J11,CPX,CPY,CPZ,V,X	VPC01394
	IF (NVLCOUNT,EG,0) GO TO 69	VPC01395
	IC=J11	VPC01396
	WRITE (7,746) IC,CPX,CPY,CPZ,V,X	VPC01397
69	CONTINUE	VPC01398
	GO TO 99	VPC01399
2	STOP	VPC01400
	END	VPC01401

	SUBROUTINE CRUCI(NC,D,X,Y,VS,XS)	VPC02 1
C		VPC02 2
C	VERSION: VPATH2	VPC02 3
C		VPC02 4
C		VPC02 5
C	USING (X,Y) AS COORDINATES IN THE CROSS FLOW PLANE.	VPC02 6
C	THIS SUBROUTINE COMPUTES THE CROSSEFLOW VELOCITY COMPONENTS AT A POINT	VPC02 7
C	(X,Y) DUE TO THE DEFLECTION OF A SINGLE FIN IN A WING - BODY COMBINATION	VPC02 8
C	THE ANGLE OF DEFLECTION IS 0 RADIANS AND THE FIN THAT IS DEFLECTED IS	VPC02 9
C	IDENTIFIED BY THE CODE NC. IF NC=1 THE RIGHT HORIZONTAL FIN IS DEFLECTED	VPC02 10
C	IF NC=2 ETC. WE COUNT COUNTERCLOCKWISE. . NUMERICAL INTEGRATION IS USED	VPC02 11
C	TO DETERMINE THE VELOCITIES. THE ACCURACY OF INTEGRATION IS DETERMINED	VPC02 12
C	THE TOLERANCE TOL = IN THE DATA STATEMENT. A POINT NEAR THE BODY	VPC02 13
C	MAY HAVE MANY INTEGRATION POINTS. THE SCHEME IS SINGULAR ON THE BODY.	VPC02 14
C		VPC02 15
	COMMON/BLK1/A,R,S,PI,CI	VPC02 16
	COMMON AA,SIG,SS,GAM	VPC02 17
	EXTERNAL FCT	VPC02 18
	COMPLEX CJ,TAU,TI,TPA,SIG,SS,EGP,EGT,TI,VEL,T2,DSO1,TP2,TH2,TP4,	VPC02 19
	IFCT, T21,T22,SIMP,T20	VPC02 20
	DATA TOL/.02/	VPC02 21
	SCA=R	VPC02 22
	X=X/SCA	VPC02 23
	Y=Y/SCA	VPC02 24
	A=A/SCA	VPC02 25
	AA=A*A	VPC02 26
	GAM=.5*ACOS(AA)	VPC02 27
	GAM1=.9*GAM	VPC02 28
C		VPC02 29
C	TRANSFORM X,Y TO PROPER QUADRANT	VPC02 30
C		VPC02 31
	TH=FLOAT(NC)*PI/2.	VPC02 32
	XS=X*COS(TH)+Y*SIN(TH)	VPC02 33
	YS=Y*COS(TH)-X*SIN(TH)	VPC02 34
	TAU=C*PI*(XS,ABS(YS))	VPC02 35
	TI=TAU*TAU	VPC02 36

TPA=TT+AA*AA/TT	VPC02 37
TM2=TPA-2.	VPC02 38
TP2=TPA+2.	VPC02 39
IF(AIMAG(TM2).GE.0.)TM2=CSQRT(TM2)	VPC02 40
IF(AIMAG(TM2).LT.0.)TM2=-CSQRT(TM2)	VPC02 41
IF(AIMAG(TP2).GE.0.)TP2=CSQRT(TP2)	VPC02 42
IF(AIMAG(TP2).LT.0.)TP2=-CSQRT(TP2)	VPC02 43
TP4=TP2+TM2	VPC02 44
SIG=.5*(TM2+TP2)	VPC02 45
SS=SIG*SIG	VPC02 46
EGP=CEXP(CI*GAM)	VPC02 47
EGM=1./EGP	VPC02 48
T1=A*(1./(SIG-EGP))-1./(SIG+EGM)	VPC02 49
NG=10	VPC02 50
T20=CMPLX(0.,0.)	VPC02 51
22 T21=SIMP(0.,GAM1,NG,FCT)	VPC02 52
IF(CABS(T21-T20)/CABS(T21).LT.TOL)GO TO 21	VPC02 53
IF(NG.GT.3000)WRITE(6,5)	VPC02 54
IF(NG.GT.3000)GO TO 21	VPC02 55
5 FORMAT(/'SOLRY DOES NOT CONVERGE IN CRUCT *//)	VPC02 56
NG=NG*2	VPC02 57
T20=T21	VPC02 58
GO TO 22	VPC02 59
21 T20=CMPLX(0.,0.)	VPC02 60
NG=20	VPC02 61
33 T22=SIMP(GAM1,GAM,NG,FCT)	VPC02 62
IF(CABS(T22-T20)/CABS(T22).LT.TOL)GO TO 31	VPC02 63
IF(NG.GT.3000)WRITE(6,5)	VPC02 64
IF(NG.GT.3000)GO TO 31	VPC02 65
NG=NG*2	VPC02 66
T20=T22	VPC02 67
GO TO 33	VPC02 68
31 CONTINUE	VPC02 69
T2=T21+T22	VPC02 70
DSOT=.5*(TAU-AA*AA/(TT*TAU))*(TP2+TM2)/TP4	VPC02 71
VEL=0*DSOT*(T1-C1+T2/SQRT(2.))/PI	VPC02 72
V=REAL(VEL)	VPC02 73
W=AIMAG(VEL)	VPC02 74
IF(YS.LT.0.)V=-V	VPC02 75
ROTATE VELOCITIES BACK	VPC02 76
VS=V*COS(TM)+W*SIN(TM)	VPC02 77
WS=V*SIN(TM)+W*COS(TM)	VPC02 78
AA=SCA	VPC02 79
XX=SCA	VPC02 80
Y=V*SCA	VPC02 81
RETURN	VPC02 82
END	VPC02 83
	VPC02 84
	VPC02 85

SUBROUTINE DASCRU (A,B,H,A,X0,PK,IER,ES,VRTMAX)

VERSION: VPATH2

THIS SUBROUTINE PERFORMS INTEGRATION

ES SHOULD BE SET TO .5 TIMES THE  
DESIRED RELATIVE PRECISION OF

VPC03 1
VPC03 2
VPC03 3
VPC03 4
VPC03 5
VPC03 6
VPC03 7
VPC03 8

	THE SOLUTION	
C		VPC03 9
C		VPC03 10
C	DIMENSION        X(1),X0(1)	VPC03 11
C	INTEGER           SW	VPC03 12
C		VPC03 13
C	LOGICAL           DE,RH,RR,RX	VPC03 14
C		VPC03 15
C	DATA             ZERO,P5,DP5,THREE,FOUR/0.,.5,1,5,3,.4,7	VPC03 16
C		VPC03 17
C	IER = 0	VPC03 18
C	IF(A = R) 4,100,0	VPC03 19
C	4 I21=H+X	VPC03 20
C	I42=I41+1	VPC03 21
C	H=IN=0,01+ABS(H)	VPC03 22
C	DE=.TRUE.	VPC03 23
C	RR=.TRUE.	VPC03 24
C	RX=.TRUE.	VPC03 25
C		VPC03 26
C		VPC03 27
C	CHECK FOR THE PROPER SIGN OF H	VPC03 28
C		VPC03 29
C	H=SIGN(ABS(H),H=A)	VPC03 30
C	X=A	VPC03 31
C	5 XS=X	VPC03 32
C	DO 10 J=1,N	VPC03 33
C	IJK0=H+J	VPC03 34
C	X(IJK0)=X0(J)	VPC03 35
C	10 CONTINUE	VPC03 36
C	15 H=H	VPC03 37
C	G=X+H=H	VPC03 38
C	DE=.TRUE.	VPC03 39
C	IF(.NOT.((H.GT.ZERO.AND.0.GE.ZERO).OR.(H.LT.ZERO.AND.0.LE.ZERO)))	VPC03 40
C	GO TO 20	VPC03 41
C	H=H-X	VPC03 42
C	RR=.FALSE.	VPC03 43
C	20 H3=H/THREE	VPC03 44
C		VPC03 45
C	CALCULATE SOLN. AT X+H	VPC03 46
C	NOTE: ARRAY XK CONTAINS V FOR ODD INDEX, W FOR EVEN INDEX.	VPC03 47
C		VPC03 48
C		VPC03 49
C	DO 90 SW=1,5	VPC03 50
C	CALL F(X0,X,A,XK,VRTMAX)	VPC03 51
C	DO 70 I=1,N	VPC03 52
C	Q=H+X(I)	VPC03 53
C	IJK0=H+I	VPC03 54
C	IJK1=I41+I	VPC03 55
C	IJK2=I42+I	VPC03 56
C	GO TO (25,30,35,40,45),SW	VPC03 57
C	25 Q=0	VPC03 58
C	XK(IJK1)=Q	VPC03 59
C	GO TO 50	VPC03 60
C	30 R=P5+(Q+X(IJK1))	VPC03 61
C	GO TO 50	VPC03 62
C	35 R=THREE*Q	VPC03 63
C	XK(IJK2)=R	VPC03 64
C	Q=.375*(R+X(IJK1))	VPC03 65
C	GO TO 50	VPC03 66
C	40 R=X(IJK1)+FOUR*Q	VPC03 67
C	XK(IJK1)=R	VPC03 68
C	R=DP5*(R+X(IJK2))	VPC03 69
C	GO TO 50	VPC03 70
C	45 R=P5*(Q+X(IJK1))	VPC03 71

	RE ARS(M+R = DP5*(J+X(IJ*2)))	VPC03 72
50	Y0(I)=X(IJ*2)+D	VPC03 73
	IF(S=,HE,5) GO TO 70	VPC03 74
C		VPC03 75
C		VPC03 76
C		VPC03 77
	REARS(X0(I))	VPC03 78
	R=5	VPC03 79
	IF(E,GF,1,E=3) R=E+5	VPC03 80
C		VPC03 81
C		VPC03 82
C		VPC03 83
	TEST ADJUSTMENT OF THE STEP	VPC03 84
	IF(D,LT,0 .OR. (.NOT. BX)) GO TO 65	VPC03 85
	HE=,TRUE.	VPC03 86
	HE=,FALSE.	VPC03 87
	HE=5*M	VPC03 88
	IF(AHS(M),GE,MMIN) GO TO 55	VPC03 89
C		VPC03 90
C		VPC03 91
C		VPC03 92
C		VPC03 93
	THE STEP IS HALVED RESTORE X AND X0,	VPC03 94
	AND GO BACK FOR REPEATED INTEGRATION	VPC03 95
	WITH THIS NEW STEP	VPC03 96
		VPC03 97
	M=SIGN(1.,M)*MMIN	VPC03 98
	BX=,FALSE.	VPC03 99
55	DO 60 J=1,N	VPC03 100
	X0(J)=X(IJ*2)	VPC03 101
60	CONTINUE	VPC03 102
	Y=XS	VPC03 103
	GO TO 15	VPC03 104
65	IF(D,GE,0.03125*M) HE=,FALSE.	VPC03 105
70	CONTINUE	VPC03 106
	GO TO (75,90,M0,M5,90),S	VPC03 107
75	X=X+M3	VPC03 108
	GO TO 90	VPC03 109
80	X=X+P5*M3	VPC03 110
	GO TO 90	VPC03 111
85	X=X+P5*M	VPC03 112
90	CONTINUE	VPC03 113
C		VPC03 114
C		VPC03 115
C		VPC03 116
	TEST A POSSIBLE DOUBLING OF THE STEP	VPC03 117
	IF(.NOT. (HE.AND.MM.AND.HR)) GO TO 95	VPC03 118
	M=M+M	VPC03 119
	BX=,TRUE.	VPC03 120
95	HE=,TRUE.	VPC03 121
	IF(RR) GO TO 5	VPC03 122
	M=M9	VPC03 123
	IF(BX .OR. HE) GO TO 9005	VPC03 124
	IFR = 33	VPC03 125
	GO TO 9005	VPC03 126
100	DO 105 I=1,N	VPC03 127
	X0(I)=ZERO	VPC03 128
105	CONTINUE	VPC03 129
9005	RETURN	VPC03 130
	END	VPC03 131

C	SUBROUTINE F(X0,PX,A,K,VRTMAX)	VPC04	1
C	VERSION: VPATH2	VPC04	2
C		VPC04	3
C	THIS SUBROUTINE IS CALLED BY NASCRU TO CALCULATE CROSS FLOW	VPC04	4
C	PLANE VELOCITIES	VPC04	5
C		VPC04	6
C	COMPLEX CI,Z,FCT,SIMP	VPC04	7
C	COMMON/VEL/AL,RE,01,02,03,04,VX(50),VY(50),G(50),NV,NDEL,NS,NF,	VPC04	8
C	IXE(7),YF(7),YF(7),C(7,7),IFIN	VPC04	9
C	COMMON/HLK1/A,K,S,PI,CI	VPC04	10
C	COMMON/HLK2/AC,PHI	VPC04	11
C	COMMON/PTNLE/XLE(80),CGLOC(80),GAMLE(80),MSAR,MSWL,MSWU,MS+0,	VPC04	12
C	I,NEDGV,XTIPLE	VPC04	13
C	COMMON/STDEEG/XSE(80),CGSELC(80),GAMSE(80),NCH,NSIDGE,XTIPTE	VPC04	14
C		VPC04	15
C	DIMENSION X0(1),KK(1),V(50),K(50),VV(50),WW(50),NCC(4)	VPC04	16
C		VPC04	17
C	EXTERNAL Z,FCT,SIMP	VPC04	18
C	CI=CMPIX(0.,1.)	VPC04	19
C	PI=3.14159265	VPC04	20
C	DO 888 I=1,NV	VPC04	21
C	J=2*I-1	VPC04	22
C	K=J+1	VPC04	23
C	VX(I)=X0(J)	VPC04	24
C	VY(I)=X0(K)	VPC04	25
C	CALL SHAPE(PX,A,S)	VPC04	26
C		VPC04	27
C	NOTE: COORDINATE VX(I) IS THE Y-COORDINATE IN THE CROSS FLOW PLANE.	VPC04	28
C	COORDINATE VY(I) IS THE Z-COORDINATE IN THE CROSS FLOW PLANE.	VPC04	29
C		VPC04	30
C	.. COMPUTE VELOCITIES IN THE CROSSFLOW PLANE ...	VPC04	31
C	V(I) IS IN THE Y-DIRECTION,	VPC04	32
C	+ (I) IS IN THE Z-DIRECTION.	VPC04	33
C		VPC04	34
C		VPC04	35
C	R=SQRT(.5*(S+S+A**4/(S+S)))	VPC04	36
C	DO 31 J=1,4	VPC04	37
C	31 NCC(J)=0	VPC04	38
C	IF(01.NE.0.)NCC(1)=1	VPC04	39
C	IF(02.NE.0.)NCC(2)=1	VPC04	40
C	IF(03.NE.0.)NCC(3)=1	VPC04	41
C	IF(04.NE.0.)NCC(4)=1	VPC04	42
C	MM=NCC(2)+NCC(4)	VPC04	43
C	NV=NCC(1)+NCC(3)	VPC04	44
C	DO 100 I=1,NV	VPC04	45
C	X=VX(I)	VPC04	46
C	Y=VY(I)	VPC04	47
C	VS=0.	VPC04	48
C	+S=0.	VPC04	49
C	IF(AL.NE.0.)CALL PITRUL(AL,X,Y,VS,NS)	VPC04	50
C	V(I)=VS	VPC04	51
C	+ (I)=-S	VPC04	52
C	IF(RE.EQ.0.)GO TO 17	VPC04	53
C	CALL PITRUL(RE,Y,-X,VS,+S)	VPC04	54
C	V(I)=V(I)+S	VPC04	55
C	+ (I)=- (I)+VS	VPC04	56
C	17 CONTINUE	VPC04	57
C	IF(NDEL.EQ.0.GD,IFIN.EQ.0)GO TO 60	VPC04	58
C	IF(MH.EQ.0)GO TO 6	VPC04	59
C	IF(M+EQ.1)GO TO 5	VPC04	60
C	CALL 9VFAIA(I,04,X,Y,VS,+S)	VPC04	61
C	V(I)=V(I)+VS	VPC04	62
C		VPC04	63

```

      W(I)=W(I)+*S
5  CONTINUE
      IF (MV.EQ.2) GO TO 8
      IF (NCC(2).EQ.1) NC=1
      IF (NCC(4).EQ.1) NC=3
      IF (NCC(2).EQ.1) DD=02
      IF (NCC(4).EQ.1) DD=04
      CALL CRUCI(NC,DD,X,Y,VS,*S)
      V(I)=V(I)+VS
      W(I)=W(I)+*S
      GO TO 6
8  DD=02=04
      CALL CRUCI(1,DD,X,Y,VS,*S)
      V(I)=V(I)+VS
      W(I)=W(I)+*S
6  CONTINUE
      IF (MV.EQ.0) GO TO 66
      IF (MV.EQ.1) GO TO 55
      CALL SYMFIN(2,03,X,Y,VS,*S)
      V(I)=V(I)+VS
      W(I)=W(I)+*S
55 CONTINUE
      IF (MV.EQ.2) GO TO 88
      IF (NCC(1).EQ.1) NC=2
      IF (NCC(3).EQ.1) NC=4
      IF (NCC(1).EQ.1) DD=01
      IF (NCC(3).EQ.1) DD=03
      CALL CRUCI(NC,DD,X,Y,VS,*S)
      V(I)=V(I)+VS
      W(I)=W(I)+*S
      GO TO 66
88 DD=01=03
      CALL CRUCI(2,DD,X,Y,VS,*S)
      V(I)=V(I)+VS
      W(I)=W(I)+*S
66 CONTINUE

```

C IF FIN LE VORTICITY IS INCLUDED, DETERMINE MV INTERPOLATION THE  
C EFFECTS OF THE SPECIFIED VORTICITY.

C NOTE: HERE IFIN=1...RIGHT FIN  
C 2...LEFT FIN  
C 3...UPPER FIN  
C 4...LOWER FIN.  
C

```

      IF (NEDGV.EQ.0) GO TO 20
      IFIN=1
      KSTART=1
      KUL=MSWR
23 CONTINUE
      IF (IFIN.EQ.5) GO TO 20
      IF (IFIN.EQ.2) KSTART=MSWR+1
      IF (IFIN.EQ.3) KSTART=MSWR+MS-L+1
      IF (IFIN.EQ.4) KSTART=MSWR+MS-L+MS-U+1
      DO 21 IFV=KSTART,KUL
      IF (PX,LY,XLE(KSTART)) GO TO 20
      JV=IFV-1
      IF (IFV.EQ.1) JV=1
      IF (PX,LE,XLE(IFV)) GO TO 22
21 CONTINUE
      IF (PX,LE,X(TIPLE)) GO TO 3A
      GO TO 20
22 KV=JV+1

```

VPC04 64  
VPC04 65  
VPC04 66  
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VPC04120  
VPC04121  
VPC04122  
VPC04123  
VPC04124  
VPC04125  
VPC04126

x1=xle(jv)	vpc04127
x2=xle(kv)	vpc04128
x11=(x2-px)/(x2-x1)	vpc04129
x12=(px-x1)/(x2-x1)	vpc04130
if (ifin.eq.3.or.ifin.eq.4) go to 24	vpc04131
vvint=x1*cgloc(jv)+x12*cgloc(kv)	vpc04132
zvhar=(px-xf(1))*tan(al/2,0)	vpc04133
gamint=x1*gamle(jv)+x12*gamle(kv)	vpc04134
go to 39	vpc04135
34 gamint=gamle(kul)	vpc04136
if (ifin.eq.3.or.ifin.eq.4) go to 40	vpc04137
vvint=cgloc(kul)	vpc04138
zvhar=(px-xf(1))*tan(al/2,0)	vpc04139
go to 39	vpc04140
40 vvint=cgloc(kul)	vpc04141
zvhar=(px-xf(1))*tan(al/2,0)	vpc04142
go to 41	vpc04143
39 call vvfls(1,x,y,vvint,zvhar,gamint,a,vs,ns,vrtmax)	vpc04144
go to 25	vpc04145
24 vvint=x1*cgloc(jv)+x12*cgloc(kv)	vpc04146
zvhar=(px-xf(1))*tan(al/2,0)	vpc04147
gamint=x1*gamle(jv)+x12*gamle(kv)	vpc04148
41 call vvfls(1,x,y,vvint,zvhar,gamint,a,v,ns,vrtmax)	vpc04149
25 v(i)=v(i)+vs	vpc04150
w(i)=w(i)+ws	vpc04151
ifin=ifin+1	vpc04152
if (ifin.eq.2) kul=ns+r+msw	vpc04153
if (ifin.eq.3) kul=ns+r+msw+msu	vpc04154
if (ifin.eq.4) kul=ns+r+msw+msu+msd	vpc04155
go to 23	vpc04156
20 continue	vpc04157
C	
C	
C IF FIN SP VORTICITY IS INCLUDED, DETERMINE BY INTERPOLATION THE	
C EFFECTS OF THE SPECIFIED VORTICITY.	
C	
if (nsidge.eq.0) go to 28	vpc04158
ifin=1	vpc04159
kstart=1	vpc04160
kul=ncw	vpc04161
27 continue	vpc04162
if (ifin.eq.5) go to 28	vpc04163
if (ifin.eq.2) kstart=ncw+1	vpc04164
if (ifin.eq.3) kstart=2*ncw+1	vpc04165
if (ifin.eq.4) kstart=3*ncw+1	vpc04166
do 29,jse=kstart,kul	vpc04167
if (px.lt.xse(kstart)) go to 28	vpc04168
jvse=jse-1	vpc04169
if (jse.eq.1) jvse=1	vpc04170
if (px.lt.xse(jvse)) go to 30	vpc04171
29 continue	vpc04172
if (px.lt.xtjpte) go to 51	vpc04173
go to 28	vpc04174
30 kvse=jvse+1	vpc04175
x1=xse(jvse)	vpc04176
x2=xse(kvse)	vpc04177
x11=(x2-px)/(x2-x1)	vpc04178
x12=(px-x1)/(x2-x1)	vpc04179
if (ifin.eq.3.or.ifin.eq.4) go to 32	vpc04180
vvint=x1*cgsele(jvse)+x12*cgsele(kvse)	vpc04181
zvhar=(px-xf(1))*tan(al/2,0)	vpc04182
gamint=x1*gamse(jvse)+x12*gamse(kvse)	vpc04183
go to 50	vpc04184
	vpc04185
	vpc04186
	vpc04187
	vpc04188
	vpc04189



51	GAMINT=GAMSE(KUL)	VPC04190
	IF (IFIN.EQ.3.OR,IFIN.EQ.4) GO TO 52	VPC04191
	YVINT=CGSELC(KUL)	VPC04192
	ZVBAR=(PX-XF(1))*TAN(AL/2,0)	VPC04193
	GO TO 59	VPC04194
52	ZVINT=CGSELC(KUL)	VPC04195
	YVBAR=-(PX-XF(1))*TAN(BE/2,0)	VPC04196
	GO TO 53	VPC04197
59	CALL VVELS (1,X,Y,YVINT,ZVBAR,GAMINT,A,VS,WS,VRTMAX)	VPC04198
	GO TO 35	VPC04199
32	ZVINT=WT1*CGSELC(JVSE)+WT2*CGSELC(KVSE)	VPC04200
	YVBAR=-(PX-XF(1))*TAN(BE/2,0)	VPC04201
	GAMINT=WT1*GAMSE(JVSE)+WT2*GAMSE(KVSE)	VPC04202
53	CALL VVELS(1,X,Y,YVBAR,ZVINT,GAMINT,A,VS,WS,VRTMAX)	VPC04203
35	V(I)=V(I)+VS	VPC04204
	W(I)=W(I)+WS	VPC04205
	IFIN=IFIN+1	VPC04206
	IF (IFIN.EQ.2) KUL=2*NCW	VPC04207
	IF (IFIN.EQ.3) KUL=3*NCW	VPC04208
	IF (IFIN.EQ.4) KUL=4*NCW	VPC04209
	GO TO 27	VPC04210
28	CONTINUE	VPC04211
100	CONTINUE	VPC04212
	CALL VOTEX(NV,VX,VY,G,VV,*)	VPC04213
	CAL=COS(AC)	VPC04214
	DO 101 I=1,NV	VPC04215
	V(I)=V(I)+VV(I)	VPC04216
	W(I)=W(I)+WW(I)	VPC04217
	J=2*I-1	VPC04218
	K=J+1	VPC04219
	W(K)=V(I)/CAL	VPC04220
	W(K)=W(I)/CAL	VPC04221
101	CONTINUE	VPC04222
	RETURN	VPC04223
	END	VPC04224

	COMPLEX FUNCTION FCT(T)	VPC05 1
C		VPC05 2
C	VERSION: VPATH2	VPC05 3
C		VPC05 4
C	FCT IS THE INTEGRAND OF THE INTEGRAL ASSOCIATED WITH VELOCITY	VPC05 5
C	COMPONENTS FOR THE SINGLY DEFLECTED FIN CASE.	VPC05 6
C		VPC05 7
	COMPLEX SIG,SS	VPC05 8
	COMMON AA,SIG,SS,GAM	VPC05 9
	TE=COS(2.*T)-AA	VPC05 10
	IF(T.GE.GAM)TE=0.	VPC05 11
	FCT=2.*(SQRT(TE-1)+SQRT(COS(2.*T)+AA-1))*((SS+1.)*COS(T)	VPC05 12
	1-2.*SIG)/((SS-2.*SIG*COS(T)+1.)*(SS-2.*SIG*COS(T)+1.))	VPC05 13
	RETURN	VPC05 14
	END	VPC05 15

```

C SUBROUTINE PITROL(AL,X,Y,VS,AS) VPC06 1
C VERSION: VPATH2 VPC06 2
C VPC06 3
C VPC06 4
C THIS SUBROUTINE COMPUTES THE CROSSFLOW VELOCITY COMPONENTS FOR A CROSS VPC06 5
C WING BODY CONFIGURATION AT ANGLE OF ATTACK AL, AND SIDESLIP ANGLE BE VPC06 6
C VPC06 7
C COMMON/BLK1/A,B,S,PI,CI VPC06 8
C COMPLEX Z,C,ZA,SO,SOS,VELAL VPC06 9
C AA=AA*8 VPC06 10
C Z=CMPLX(X,Y) VPC06 11
C ZA=Z+AA/Z VPC06 12
C SA=S+AA/S VPC06 13
C SO=ZA*ZA-SA*SA VPC06 14
C AY=1.0 VPC06 15
C IF(AIMAG(ZA).LT.0.0) AY=-1.0 VPC06 16
C AYZ=1.0 VPC06 17
C IF(AIMAG(SO).LT.0.0) AYZ=-1.0 VPC06 18
C SOS=CSORT(SO)*AY*AYZ VPC06 19
C IF((ABS(AIMAG(ZA)).LE.0.0).AND.(REAL(ZA).LT.0.0))SOS=CMPLX(-REAL(SVPC06 20
C 10S),AIMAG(SOS)) VPC06 21
C VELAL=-C*SIN(AL)*(1.-AA/Z**2)*ZA/SOS VPC06 22
C VPC06 23
C VS=...SIDEWASH INCLUDING FREE STREAM COMPONENT VPC06 24
C WS=...UPWASH INCLUDING FREE STREAM COMPONENT VPC06 25
C VPC06 26
C VS=REAL(VELAL) VPC06 27
C WS=-A*MAG(VELAL) VPC06 28
C RETURN VPC06 29
C END VPC06 30

```

```

C SUBROUTINE PLOTVB(X,Y,Z,NP,N(PI,NVN,NOP,ROT,XF,YF,NF,X2,Y2) VPC07 1
C VERSION: VPATH2 VPC07 2
C VPC07 3
C ROUTINE TO GENERATE A PLOT VORTEX LOCATION RELATIVE TO VPC07 4
C THE WING-BODY CONFIGURATION VPC07 5
C DEFINITIONS: VPC07 6
C NC = INDEX OF CURVE VPC07 7
C NPI = NO. OF BODY STATIONS VPC07 8
C NVN = NO. OF VORTICES VPC07 9
C NF = NO. OF WING DEFINITION CARDS VPC07 10
C VPC07 11
C DIMENSION X(NOP,52),Y(NOP,52),Z(NOP,52) VPC07 12
C DIMENSION NP(52),ROT(1),XCG(3),XF(7),YF(7) VPC07 13
C DIMENSION X2(17,18),Y2(17,18),NP2(18),SYMHOL(40) VPC07 14
C VPC07 15
C DATA L=10,LENG,XCG/100,SO,0.,0.,0./ VPC07 16
C DATA SYMHOL / 1H+,1H+,1H+,1H+,1H0,1H1,1H2,1H3,1H4,1H5,1H6, VPC07 17
C 1H7,1H8,1H9,1H4,1H8,1H0,1H0,1H6,1H6,1H0,1H4,1H3,1H3,1H4, VPC07 18
C 1H4,1H4,1H0,1H0,1H0,1H8,1H8,1H1,1H0,1H0,1H4,1H4,1H2/ VPC07 19
C WRITE(6,10) VPC07 20
C WRITE(A,11) VPC07 21
C 10 FORMAT(1H1) VPC07 22
C 11 FORMAT(1H7) VPC07 23
C VPC07 24
C FIND MAXIMUM DIAMETER VPC07 25
C VPC07 26
C VPC07 27

```

HMAX=0.	VPC07 28
DO 100 I=1,NIP1	VPC07 29
100 RMAX=AMAX1(HMAX,Y(1,I+1),Z(1,I+1))	VPC07 30
C	VPC07 31
C CURVE 1: DRAW AXES	VPC07 32
C	VPC07 33
NC=1	VPC07 34
DO 120 I=1,6	VPC07 35
X(I,1)=X(1,1)	VPC07 36
Y(I,1)=0.	VPC07 37
120 Z(I,1)=0.	VPC07 38
X(2,1)=X(1,NIP1+1)	VPC07 39
Y(4,1)=1.5*HMAX	VPC07 40
Z(6,1)=1.5*RMAX	VPC07 41
NP(1)=6	VPC07 42
C	VPC07 43
C CURVES: 2 TO NIP1+1	VPC07 44
C GENERATE CROSS SECTIONS	VPC07 45
C	VPC07 46
NGV=NIP1+NVN+3	VPC07 47
NERID=17	VPC07 48
DO 160 J=1,NIP1	VPC07 49
NC=NC+1	VPC07 50
R1=X(1,NC)	VPC07 51
RLOC=Y(1,NC)	VPC07 52
RLOC=Z(1,NC)	VPC07 53
SLOC=Y(2,NC)	VPC07 54
C SAVE RLOC AND SLOC	VPC07 55
Y(J,NGV)=RLOC	VPC07 56
Z(J,NGV+1)=RLOC	VPC07 57
Y(J,NGV+2)=SLOC	VPC07 58
C	VPC07 59
C GENERATE BODY CROSS SECTION	VPC07 60
C	VPC07 61
DTM=2.*3.1415926/(NERID-1)	VPC07 62
DO 140 I=1,NERID	VPC07 63
PHI=(I-1)*DTM	VPC07 64
RAD=(COS(PHI)/RLOC)**2+(SIN(PHI)/SLOC)**2	VPC07 65
RAD=SQRT(1./RAD)	VPC07 66
Y(1,NC)=RAD*SIN(PHI)	VPC07 67
Z(1,NC)=RAD*COS(PHI)	VPC07 68
X(1,NC)=R1	VPC07 69
140 CONTINUE	VPC07 70
160 NP(NC)=NERID	VPC07 71
C	VPC07 72
C PLOT VORTEX LOCATION (ALREADY DEFINED)	VPC07 73
C	VPC07 74
DO 170 I=1,NVN	VPC07 75
NC=NC+1	VPC07 76
170 NP(NC)=NIP1	VPC07 77
C	VPC07 78
C WING OUTLINE	VPC07 79
C	VPC07 80
IF (NF.LE.0) GO TO 200	VPC07 81
DO 190 J=1,2	VPC07 82
NC=NC+1	VPC07 83
SGN=(-1)**(J+1)	VPC07 84
DO 180 I=1,NF	VPC07 85
X(1,NC)=XF(I)	VPC07 86
Y(1,NC)=YF(I)*SGN	VPC07 87
Z(1,NC)=0.	VPC07 88
180 CONTINUE	VPC07 89
NF1=NF+1	VPC07 90

	X(NF1,NC)=XF(1)	VPC07 91
	Y(NF1,NC)=YF(1)*SGN	VPC07 92
	Z(NF1,NC)=0.0	VPC07 93
	NP(NC1)=NF1	VPC07 94
190	CONTINUE	VPC07 95
200	CONTINUE	VPC07 96
C		VPC07 97
C	PLOT CROSS SECTIONS WITH VORTEX LOCATIONS -----	VPC07 98
C		VPC07 99
	DO 240 ISECTN=1,5	VPC07100
	IF (ISECTN.EQ.1) JSECTN=1	VPC07101
	IF (ISECTN.EQ.2) JSECTN=NIP1/2	VPC07102
	IF (ISECTN.EQ.3) JSECTN=NIP1	VPC07103
C		VPC07104
C	COPY BODY	VPC07105
C		VPC07106
	DO 220 I=1,MERID	VPC07107
	X2(I,1)=Y(I,JSECTN+1)	VPC07108
	Y2(I,1)=Z(I,JSECTN+1)	VPC07109
220	CONTINUE	VPC07110
	NP2(1)=MERID	VPC07111
	NC2=1	VPC07112
C		VPC07113
C	ATING OUTER BOUNDARIES	VPC07114
C		VPC07115
	SLCC=Y(JSECTN,NGV+2)	VPC07116
	X2(1,2)=SLCC	VPC07117
	Y2(1,2)=0.	VPC07118
	X2(2,2)=SLCC	VPC07119
	Y2(2,2)=0.	VPC07120
	NP2(2)=2	VPC07121
	NC2=NC2+1	VPC07122
C		VPC07123
C	COPY VORTICES AT JSECTN	VPC07124
C		VPC07125
	DO 230 J=1,NVN	VPC07126
	NC2=NC2+1	VPC07127
	JCV=NIP1+1+J	VPC07128
	X2(1,NC2)=Y(JSECTN,JCV)	VPC07129
	Y2(1,NC2)=Z(JSECTN,JCV)	VPC07130
	NP2(NC2)=1	VPC07131
230	CONTINUE	VPC07132
C		VPC07133
C	PLOT CROSS SECTIONS	VPC07134
C		VPC07135
	CALL PLOT2(X2,Y2,3,NP2,17,NC2,L*10,LENG)	VPC07136
	WRITE(6,23) JSECTN,X(1,JSECTN+1)	VPC07137
	WRITE(6,24) (I,SYMBOL(I+2),I=1,NVN)	VPC07138
240	CONTINUE	VPC07139
C		VPC07140
C	PLOT PERSPECTIVE VIEWS -----	VPC07141
C		VPC07142
C	TOP VIEW	VPC07143
	CALL PLOT2(X,Y,3,NP,NBP,NC,L*10,LENG)	VPC07144
C	CALL PLOT2(X,Y,3,NP,NBP,NC,L*10,LENG,LINE,NLIP)	VPC07145
	WRITE(4,20)	VPC07146
	NSYM=NVN	VPC07147
	JSYM=1+NIP1	VPC07148
	JN=JSYM+NVN	VPC07149
	IF (JN.GT.40) NSYM=JN-30	VPC07150
	WRITE(6,24) (I,SYMBOL(1+JSYM),I=1,NSYM)	VPC07151
	IF (JN.LE.40) GO TO 210	VPC07152
		VPC07153

```

      JSYM=JSYM+1
      ISYM = JSYM
      WRITE(6,24) (I,SYMBOL(I+ISYM),I=JSYM,NVM)
210  CONTINUE
C
C   SIDE VIEW
      CALL PLOT42(X,Z,S,NP,NOP,NC,L=10,LENG)
C   CALL PLOT42(X,Z,S,NP,NOP,NC,L=10,LENG,LINE,MLIN)
      WRITE(6,21)
C
C   PERSPECTIVE VIEW
      ROT(1) = 0.
      ROT(2)=30.
      ROT(3)=20.
      CALL PLOT43(X,Y,Z,NP,NOP,NC,ROT,XCG,X,Y,3)
      CALL PLOT42(X,Y,3,NP,NOP,NC,L=10,LENG)
C   CALL PLOT42(X,Y,3,NP,NOP,NC,L=10,LENG,LINE,MLIN)
      WRITE(6,22) ROT
C
C
20  FORMAT(/20X,22HTOP VIEW = Y VERSUS X)
21  FORMAT(/20X,22HSIDE VIEW = Z VERSUS X)
22  FORMAT(/20X,19HPERSPECTIVE = ROT=,3F10,2)
23  FORMAT(/20X,29HBODY CROSS SECTION = JSECT=,I3,
*      5X,4MX10=,F10,3)
24  FORMAT(20X,14HVERTICAL SYMBOL1,10(1X,I2,1H=,A1,1H,))
C
C   RETURN
      END

```

VPC07154  
VPC07155  
VPC07156  
VPC07157  
VPC07158  
VPC07159  
VPC07160  
VPC07161  
VPC07162  
VPC07163  
VPC07164  
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VPC07178  
VPC07179  
VPC07180  
VPC07181  
VPC07182

```

      SUBROUTINE SHAPE(X,R,S)
C
C   VERSION: VPATH2
C
C   SUBROUTINE TO COMPUTE LOCAL BODY RADII AND FIN SPAN MEASURED FROM
C   THE BODY CENTERLINE
C
      COMMON/VEL/AL,BE,01,02,03,04,VX(30),VY(30),G(30),NV,NDEL,NS,VF,
      IXE(7),XFE(7),YF(7),C(7,7),IFIN
      IFIN=0
      DO 1 K=1,NS
      XL=XE(K)
      J=K
      IF(X,LE,XL)GO TO 2
1  CONTINUE
2  R=C(J,1)+X+C(J,5)+X+C(J,6)
      ARG=X+Y+C(J,2)+X+C(J,3)+C(J,4)
      R=R+SQRT(ARG)*C(J,7)
      S=R
      IF(NF,0,0)RETURN
      IF(X,LE,XF(1),OR,X,GT,XF(NF))RETURN
      IFIN=1
      DO 3 K=2,NF
      J=K
      XL=XF(K)
      IF(X,LE,XL)GO TO 4
3  CONTINUE
4  J1=J-1
      S=(X-XF(J1))*(YF(J)-YF(J1))/(XF(J)-XF(J1))+YF(J1)
      RETURN
      END

```

VPC08 1  
VPC08 2  
VPC08 3  
VPC08 4  
VPC08 5  
VPC08 6  
VPC08 7  
VPC08 8  
VPC08 9  
VPC08 10  
VPC08 11  
VPC08 12  
VPC08 13  
VPC08 14  
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VPC08 20  
VPC08 21  
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VPC08 23  
VPC08 24  
VPC08 25  
VPC08 26  
VPC08 27  
VPC08 28  
VPC08 29  
VPC08 30  
VPC08 31

COMPLEX FUNCTION SIMP(A,B,N,F)

VERSION: VPATH2

SIMP INTEGRATES THE INTEGRAL INVOLVING FCT AS SET UP IN CRUCI

EXTERNAL F

COMPLEX F,SUMEND,SUMID

TANH=(B-A)/N

H=TANH/2.

SUMEND=CMPLX(0.,0.)

SUMID=CMPLX(0.,0.)

DO 1 K=1,N

X=A+FLOAT(K-1)\*TANH

SUMEND=SUMEND+F(X)

1 SUMID=SUMID+F(X+H)

SIMP=(2.\*SUMEND+4.\*SUMID-F(A)+F(B))\*H/3.

RETURN

END

SUBROUTINE SYMFIN(NC,O,X,Y,VS,WS)

VERSION: VPATH2

THIS SUBROUTINE COMPUTES THE CROSSFLOW VELOCITY COMPONENTS VS,WS

AT THE POINT X,Y, INDUCED BY A SYMMETRIC DEFLECTION OF A PAIR OF FIVPC10

BY AN ANGLE O RADIANS IN A CRUCIFORM WING BODY COMBINATION. THE CCVPC10

NC DETERMINES WHICH PAIR OF FINS ARE DEFLECTED. IF NC=1, HORIZONTAL VPC10

IF NC=2 IT IS THE VERTICAL PAIR.

COMMON/HL<1/A,R,S,PI,CI

COMPLEX CI,T,TT,TPA,SQ,CC, T2,T3,T4,VEL,T,AT,CLT,ARG,TINV,CCS

R0=.5\*(S+AA/R)

XS=X

YS=Y

IF THE VERTICAL FINS ARE DEFLECTED ROTATE (X,Y) BY PI/2

IF(NC.NE.2)GO TO 1

XS=Y

YS=-X

1 T=CMPLX(ABS(XS),ABS(YS))

TT=T\*T

AA=AA

TPA=TT+AA

R0=R0+R0

SQ=TPA+TPA

TN=TT-AA

CCS=SQ+.4.\*R0\*TT

SRT=SRT(1.-AA/R0)

IF(ATANH(CCS).GE.0.)CC=CSQRT(CCS)

IF(A[=AR(CCS),LT.0.)CC=-CSQRT(CCS)

SECOND TERM

TI=TPA+SRT/(A+CC/R0)

ARG=(CI+TI)/(CI-TI)

CLT=CLC(ANG)

TINV=CI+.5\*CLT

T2=(TN/TT)\*.5\*CLT

C...	THIRD TERM	VPC10	40:
	T3=CI*PI*.5*TPA/TT	VPC10	41:
C....	FOURTH TERM	VPC10	42:
	T4=CI+TMA*TPA*(PI*.5+ACOS(A/R0))/(CC+TT)	VPC10	43:
C....	VELOCITY	VPC10	44:
	VEL=0*(T2+T3+T4)/PI	VPC10	45:
	V=REAL(VEL)	VPC10	46:
	W=AI*AG(VEL)	VPC10	47:
	IF(XS*YS,LT,0.)V=-V	VPC10	48:
	VS=V	VPC10	49:
	WS=V	VPC10	50:
	IF(FC.NE.2)RETURN	VPC10	51:
	VS=-V	VPC10	52:
	WS=V	VPC10	53:
	RETURN	VPC10	54:
	END	VPC10	55:

	SUBROUTINE VUTEX(NV,XV,YV,GV,VV,WW)	VPC11	1:
C		VPC11	2:
C	VERSION: VPATH2	VPC11	3:
C		VPC11	4:
C	THIS SUBROUTINE COMPUTES THE PERTURBATION VELOCITY COMPONENTS AT THE	VPC11	5:
C	VORTEX LOCATIONS ACCOUNTING FOR MUTUAL EFFECTS AND THE PRESENCE	VPC11	6:
C	OF A CRUCIFORM WING BODY COMBINATION	VPC11	7:
C		VPC11	8:
	DIMENSION XV(30),YV(30),GV(30),VV(30),WW(30)	VPC11	9:
	DIMENSION VX(30),VY(30),G(30)	VPC11	10:
	COMMON/VV/AA,R4	VPC11	11:
	COMMON/SLK1/A,R,S,PI,CI	VPC11	12:
	EXTERNAL Z	VPC11	13:
	COMPLEX CI,T0,Z,S0,T2,S2,T3,S3,T4,S4,TM44,SMR4,DSOT,DTOS,D2SOT	VPC11	14:
	I,V1,V2,V3,VEL,TAU,S1,SOB,SIN	VPC11	15:
	NN=NV-1	VPC11	16:
	AA=AA+A	VPC11	17:
	AA=AA*AA	VPC11	18:
	GR=0*W	VPC11	19:
	R4=RR+RR	VPC11	20:
	DO 100 I=1,NV	VPC11	21:
	X0=XV(I)	VPC11	22:
	Y0=YV(I)	VPC11	23:
	G0=GV(I)	VPC11	24:
	K1=0	VPC11	25:
	DO 99 J=1,NV	VPC11	26:
	IF(J.EQ.I)GO TO 99	VPC11	27:
	K1=K1+1	VPC11	28:
	VX(K1)=XV(J)	VPC11	29:
	VY(K1)=YV(J)	VPC11	30:
	G(K1)=GV(J)	VPC11	31:
99	CONTINUE	VPC11	32:
	T0=CMPLX(X0,Y0)	VPC11	33:
	S0=Z(T0)	VPC11	34:
	SOB=CONJG(S0)	VPC11	35:
	T2=T0+T0	VPC11	36:
	T3=TC+T2	VPC11	37:
	T4=T2+T2	VPC11	38:
	S2=S0+S0	VPC11	39:
	S3=S2+S0	VPC11	40:
	S4=S2+S2	VPC11	41:
	TM44=T4-AA	VPC11	42:
	SMR4=S4-AA	VPC11	43:

DSOT=TH44*S3/(T3+SH44)	VPC11 44
STDS=SH44+T3/(S3+TH44)	VPC11 45
D2SDT=S3*(T3+3.*A4)/(SH44+T4)=S2*DSOT*TH44*(S4+3.*R4)/	VPC11 46
1 (T3+SH44+SH44)	VPC11 47
V1=-GD*STDS*D2SDT/2.	VPC11 48
V2=GD*DSOT*SDR/(SDR+SD=RW)	VPC11 49
V3=CPLX(G.,P.)	VPC11 50
DO 3 K=1,N	VPC11 51
TAU=CMP(X(VX(K),VY(K))	VPC11 52
SI=Z(TAU)	VPC11 53
SIR=CONJG(SI)	VPC11 54
3 V3=V3-G(K)*(1./(SD-SI)-SIR/(SD+SIR-V2))+DSOT	VPC11 55
VEL=C*(V1+V2+V3)/(PI+P1)	VPC11 56
VV(I)=REAL(VEL)	VPC11 57
** (I)=-4*MAG(VEL)	VPC11 58
100 CONTINUE	VPC11 59
RETURN	VPC11 60
END	VPC11 61

SUBROUTINE VVELS(NV,YY,ZZ,VX,VY,G,RB,V,*,VRTMAX)	VPC12 1
VERSION: VPATH2.	VPC12 2
THIS SUBROUTINE COMPUTES PERTURBATION VELOCITY COMPONENTS DUE TO	VPC12 3
NV EXTERNAL VORTICES AND THEIR IMAGES INSIDE A BODY WITH CIRCULAR	VPC12 4
CROSS SECTION.	VPC12 5
CENTER VORTEX EFFECTS ARE NOT ACCOUNTED FOR.	VPC12 6
DIMENSION VX(1),VY(1),G(1)	VPC12 7
ILC=0.000001	VPC12 8
PI=3.1415926	VPC12 9
V=0.	VPC12 10
*R=0.	VPC12 11
V=VY/RH	VPC12 12
Z=ZZ/CH	VPC12 13
DO 1 I=1,NV	VPC12 14
GG=G(I)/(2.*PI*RB)	VPC12 15
XV=VX(I)/RB	VPC12 16
YV=VY(I)/RB	VPC12 17
ZVS=XV*XV+YV*YV	VPC12 18
DY=Y-XV	VPC12 19
DZ=Z-YV	VPC12 20
DYS=DY*DY	VPC12 21
DZS=DZ*DZ	VPC12 22
DEN1=DYS+DZS	VPC12 23
IF(DEN1.LE.ILC) GO TO 2	VPC12 24
V=V+GG*DZ/DEN1	VPC12 25
*S=GG*DY/DEN1	VPC12 26
2 DEN2=(Y-XV/ZVS)**2+(Z-YV/ZVS)**2	VPC12 27
IF(ABS(DEN2).LE.ILC) GO TO 3	VPC12 28
V=V+GG*(Z-YV/ZVS)/DEN2	VPC12 29
*S=GG*(Y-XV/ZVS)/DEN2	VPC12 30
3 CONTINUE	VPC12 31
LIMIT MAGNITUDE OF PERTURBATION VELOCITIES TO VRTMAX.	VPC12 32
1 CONTINUE	VPC12 33
IF (V,GT,0.0.AND,ABS(V),GE,VRTMAX) V=VRTMAX	VPC12 34
	VPC12 35
	VPC12 36
	VPC12 37
	VPC12 38
	VPC12 39
	VPC12 40



VPC12 41  
VPC12 42  
VPC12 43  
VPC12 44  
VPC12 45

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# PROGRAM VPATHL

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1.	VPATHL	VPL01	437
2.	DASCRU	02	443
3.	DBLU	03	445
4.	DSDZ	04	446
5.	DZDS	05	446
6.	D2SDZ2	06	447
7.	EXPAND	07	447
8.	F	08	448
9.	PITROL	09	450
10.	PLOTVB	10	451
11.	SHAPE	11	454
12.	VOTEX	12	455
13.	VVELS	13	456
14.	Z	14	457

## PROGRAM VPATHL

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C      PROGRAM VPATHL(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE4,TAPE7) VPL01 1
C      THIS PROGRAM COMPUTES THE PATHS AND VORTEX INDUCED CROSSFLOW VPL01 2
C      VELOCITIES AT SPECIFIED FIELD POINTS FOR A SET OF VORTICES IN THE VPL01 3
C      PRESENCE OF A WING-BODY COMBINATION AT ANGLE OF ATTACK AND ROLL. VPL01 4
C      SLENDER BODY THEORY IS USED IN THE COMPUTATION OF THE CROSSFLOW VPL01 5
C      VELOCITIES. THE BODY IS ASSUMED TO HAVE ELLIPTICAL CROSS SECTION. VPL01 6
C      VPL01 7
C      VPL01 8
C      VPL01 9
C      THE COORDINATE SYSTEM USED HERE IS THE BODY COORDINATE SYSTEM VPL01 10
C      WITH THE X-AXIS ALONG THE BODY CENTER-LINE STARTING AT THE NOSE TIP, VPL01 11
C      Y-AXIS TO THE RIGHT WHEN LOOKING FORWARD,Z-AXIS UP. VPL01 12
C      VPL01 13
C      VPL01 14
C      *****NOTE: WINGS ONLY - NO VERTICAL SURFACES***** VPL01 15
C      VPL01 16
C      VPL01 17
C      DIMENSION TITLE(20),XN(60),XIP(50),XK(120) VPL01 18
C      DIMENSION VXP(30,30,2),NVV(30) VPL01 19
C      VPL01 20
C      COMMON/VEL/AL,BE, VX(30),VY(30),G(30),NV, NS,NF, VPL01 21
C      IXE(7),XFE(7),YFE(7),C(7,7),IFIN VPL01 22
C      COMMON/HLK2/AC,PHI VPL01 23
C      COMMON/FINLE/XLE(80),CGLOC(80),GAMLE(80),MSWR,MSWL,MSWD,MSWD, VPL01 24
C      1,DEGCV,XTITLE VPL01 25
C      COMMON/STEDG/XSE(80),CGSELC(80),GAMSE(80),NCV,NBIOGE,XTITIE VPL01 26
C      COMMON/COMB/HFACT VPL01 27
C      COMMON XPLT(30,52),YPLT(30,52),ZPLT(30,52),NPLT(52),ROT(5) VPL01 28
C      * ,XP2(17,16),YP2(17,16) VPL01 29
C      COMMON /HSCALE/ XMAX,XMIN,YMAX,YMIN VPL01 30
C      COMMON/PARAM/ROUT VPL01 31
C      VPL01 32
C      NAMELIST/DEHUG/NS,NF,NIP,NCPIN,NVLOUT,NOUT,VRTMAX,XE,C,XF,YF,NVV VPL01 33
C      VPL01 34
C      1 FORMAT(20A4) VPL01 35
C      4 FORMAT(4I10) VPL01 36
C      5 FORMAT(7F10,5) VPL01 37
C      6 FORMAT(8F10,5) VPL01 38
C      7 FORMAT(6F10,5) VPL01 39
C      9 FORMAT(/5X,34HLOCAL BODY HORIZONTAL SEMI-AXIS = ,F10,5/5X, VPL01 40
C      1 34HLOCAL BODY VERTICAL SEMI-AXIS = ,F10,5/5X, VPL01 41
C      2 34HLOCAL SEMI SPAN S = ,F10,5/) VPL01 42
C      11 FORMAT (/5X,33H INCLUDED ANGLE OF ATTACK(DEG) = ,F10,5, VPL01 43
C      1 24H ROLL ANGLE(DEG) = ,F10,5/) VPL01 44
C      21 FORMAT(/19H X-STATION NO.,13,9H X=,F6,3,6X, VPL01 45
C      1 25H INTEGRATION STEP SIZE = ,F10,5//) VPL01 46
C      22 FORMAT(115,4X,2E17,5,F15,5) VPL01 47
C      25 FORMAT (////10X,36HVORTEX COORDINATES IN CROSSFLOW PLANE,/) VPL01 48
C      26 FORMAT (//43H INITIAL VORTEX POSITIONS AT X = ,F6,5/) VPL01 49
C      27 FORMAT (10X,7H VORTEX,10X,7H Y,VRTX,10X,7H Z,VRTX,6X, VPL01 50
C      1 10HGAMMA/VIN//) VPL01 51
C      30 FORMAT(16I5) VPL01 52
C      31 FORMAT(/// 6X,76HCROSSFLOW VELOCITIES AT CONTROL POINTS INDUCED BYVPL01 53
C      1 VORTICES AND THEIR IMAGES,/) VPL01 54
C      1 6X,2HIC,10X,6H,4H,10X,6HY,BODY,10X,6HZ,BODY,10X,1HV,15X,14H) VPL01 55
C      32 FORMAT(5X,13,6X,5F15,5) VPL01 56
C      40 FORMAT(3F10,5) VPL01 57
C      700 FORMAT (///5(1H*), 59HPERMISSIBLE RELATIVE ERROR,IS,USED IN INTEGRAVPL01 58
C      1TION SCHEME = ,F12,5/) VPL01 59
C      701 FORMAT (///5(1H*),51HSEQUENTIVE GASCORR CAN NOT OBTAIN VALUE FOR I)VPL01 60
C      1TEGRATION STEP H,5(1H*)//) VPL01 61
C      702 FORMAT (45X,13,2F10,5) VPL01 62
C      703 FORMAT (//45X,31HINTERPOLATED VORTEX COORDINATES/47X,1HI,5X, VPL01 63

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1	2HYV,10X,24ZV/)	VPL01 64
700	FORMAT (////17X,12HF IN GEOMETRY/10X,12HF IN SEMISPAN,11X,1H=,1X,	VPL01 65
A	F10.5/	VPL01 66
1	10X,25HF IN ROOTCHORD = ,F10.5/	VPL01 67
8	10X,25HF IN ROOT L.E. X-STATION= ,F10.5/	VPL01 68
2	10X,25H L.E. Y-STATION= ,F10.5/	VPL01 69
3	10X,25HF IN TIP L.E. X-STATION = ,F10.5/	VPL01 70
4	10X,25H L.E. Y-STATION = ,F10.5/	VPL01 71
5	10X,25HF IN TIP T.E. X-STATION = ,F10.5/	VPL01 72
6	10X,25H T.E. Y-STATION = ,F10.5/	VPL01 73
8	10X,25HF IN ROOT T.E. X-STATION= ,F10.5/	VPL01 74
9	10X,25H T.E. Y-STATION= ,F10.5,////)	VPL01 75
705	FORMAT (6X,12,2X,F10.5,1X,F10.5,1X,F10.5)	VPL01 76
706	FORMAT (////10X,26HF IN LEADING EDGE VORTICITY/	VPL01 77
1	5X,3HJLE,6X,1HX,7X,10HY OR Z BAR,2X,11HGAMMA/VINF,/) )	VPL01 78
707	FORMAT (////10X,25HF IN SIDE EDGE VORTICITY/5X,3HJSE,6X,1HX,7X,	VPL01 79
1	10HY OR Z BAR,2X,11HGAMMA/VINF,/) )	VPL01 80
745	FORMAT (15,3E12,5)	VPL01 81
746	FORMAT (15,5E12,5)	VPL01 82
C		VPL01 83
C		VPL01 84
C		VPL01 85
C	RAO=3.1415926/180.	VPL01 86
C		VPL01 87
C		VPL01 88
C	..... INPUT .....	VPL01 89
C		VPL01 90
99	READ(5,1)TITLE	VPL01 91
	IF(EOF(5))2,3	VPL01 92
3	CONTINUE	VPL01 93
C		VPL01 94
C	.. GEOMETRY ..	VPL01 95
C		VPL01 96
C		VPL01 97
C	NS=NO. OF BODY SECTIONS WITH DIFFERENT GEOMETRY	VPL01 98
C	NE= NO. OF CORNER POINTS USED TO DESCRIBE RIGHT WING PANEL.	VPL01 99
C	NTP= NO. OF X- STATIONS PRINTED IN OUTPUT	VPL01100
C	NCPIN,NVLOUT GOVERN READING FROM AND WRITING ON DATA SETS.	VPL01101
C	NOUT=1 GIVES ADDITIONAL OUTPUT	VPL01102
C	IPLT=0 ....NO PLOTS IN PRINTED OUTPUT	VPL01103
C	1 ....READ IN MAX. AND MIN,X*S AND Y*S	VPL01104
C	5 ....PLOTS WILL BE SIZED AUTOMATICALLY	VPL01105
C		VPL01106
C	XE= X VALUES AT THE END OF EACH BODY SECTION	VPL01107
C	C= COEFFICIENTS IN THE BODY GEOMETRY EQUATION	VPL01108
C		VPL01109
C	XF,YF= X AND Y COORDS OF THE WING BREAK IN SHEEP POINTS.	VPL01110
C		VPL01111
C	RFAC=VERTICAL AXIS/HORIZONTAL AXIS	VPL01112
C		VPL01113
C	READ(5,4)NS,NE,NIP,NCPIN,NVLOUT,NOUT,IPLT	VPL01114
C	READ(5,5) RFAC	VPL01115
C	READ(5,5)(XE(I),I=1,NS)	VPL01116
C	READ(5,5)((C(I,J),J=1,7),I=1,NS)	VPL01117
C	IF(NE,NE,0) READ(5,6)(XF(I),YF(I),I=1,NE)	VPL01118
C	IF (IPLT,EQ,1) READ (5,6) XMAX,XMIN,YMAX,YMIN	VPL01119
C		VPL01120
C		VPL01121
C	DETERMINE DISTANCE FROM BODY CENTERLINE TO WING TIP(=SEMISPAN)	VPL01122
C	AND X-LOCATIONS OF WING TIP LEADING EDGE AND TRAILING EDGE,	VPL01123
C		VPL01124
C	IF (NE,EQ,0) GO TO 84	VPL01125
C	YMAX=0	VPL01126

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      CRP=SQRT((XF(NF)-XF(1))*(XF(NF)-XF(1))+(YF(NF)-YF(1))*(YF(NF)-
1 YF(1)))
      VPL01127
      VPL01128
      DO 80 I=1,NF
      VPL01129
      IF (YF(I).GT.YMAX) YMAX=YF(I)
      VPL01130
80 CONTINUE
      VPL01131
      NF1=NF-1
      VPL01132
      DO 81 I=1,NF1
      VPL01133
      IP1=I+1
      VPL01134
      IF (YF(I).EQ.YMAX.AND.YF(IP1).EQ.YMAX) GO TO 82
      VPL01135
      IF (YF(I).EQ.YMAX) GO TO 85
      VPL01136
81 CONTINUE
      VPL01137
      GO TO 84
      VPL01138
82 IMAX=I
      VPL01139
      IMAXP1=I+1
      VPL01140
      XTIPLEX=XF(IMAX)
      VPL01141
      YTIPL= YF(IMAX)
      VPL01142
      XTIPTE=YF(IMAXP1)
      VPL01143
      YTIPT= YF(IMAXP1)
      VPL01144
      GO TO 84
      VPL01145
83 XTIPLEX=XF(IMAX)
      VPL01146
      XTIPTE=XTIPLEX
      VPL01147
84 CONTINUE
      VPL01148
      VPL01149
      VPL01150
      VPL01151
      ALFAC=INCLUDED ANGLE OF ATTACK, PHIR=ROLL ANGLE BOTH IN DEGREE
      VPL01152
      ES=PERMISSIBLE RELATIVE ERROR IN THE PATH INTEGRATION SCHEME
      VPL01153
      VPL01154
      READ(5,6)ALFAC,PHI,ES,VRTMAX
      VPL01155
      IF (VRTMAX.EQ.0.0) VRTMAX=.35
      VPL01156
      VPL01157
      .. X-STATIONS, INTEGRATION INFO, + INITIAL VORTEX POSITIONS AND STRENG
      VPL01158
      VPL01159
      VPL01160
      NVV=TOTAL NUMBER OF VORTICES AT EACH X-STATION
      VPL01161
      VPL01162
      VPL01163
      VPL01164
      READ(5,30)(NVV(I),I=1,NIP)
      VPL01165
      NV=NVV(1)
      VPL01166
      NVMAX=NVV(NIP)
      VPL01167
      VPL01168
      READ IN CROSSFLOW STARTING COORDINATES AND STRENGTHS FOR ALL
      VPL01169
      VORTICES REGARDLESS OF THE X-STATION AT WHICH THEY START.
      VPL01170
      THIS INFO MUST BE INPUT FOR INCREASING X-STATION.
      VPL01171
      HERE....VX(I)..Y-COORDINATE
      VPL01172
      VY(I)..Z-COORDINATE
      VPL01173
      G(I)..GAMMA/VINF,COUNTERCLOCKWISE POSITIVE,
      VPL01174
      WHEN VIEWING FORWARD.
      VPL01175
      VPL01176
      READ(5,7)(VX(I),VY(I),G(I),I=1,NVMAX)
      VPL01177
      DO 8 I=1,NV
      VPL01178
      J=2*I-1
      VPL01179
      K=J+1
      VPL01180
      VXP(1,I,1)=VX(I)
      VPL01181
      VXP(1,I,2)=VY(I)
      VPL01182
      XQ(J)=VX(I)
      VPL01183
      XQ(K)=VY(I)
      VPL01184
      VPL01185
      VPL01186
      XIP=X-VALUES AT THE NIP X-STATIONS AT WHICH OUTPUT REQD.
      VPL01187
      FIRST VALUE FOR XIP CAN BE ANY NUMBER LARGER THAN ZERO
      VPL01188
      INTEGRATION STARTS AT XIP(1)
      VPL01189
      INTEGRATION STEP SIZE DETERMINED BY DASCRO...
      VPL01190

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C      READ(5,6)(XIP(I),I=1,NIP)
C
C      WRITE(6,1)TITLE
C      IF (NF.NE.0)
C      1 WRITE (6,704) YMAX,CHP,XF(1),YF(1),XTIPLE,YTIPLE,XTIPTE,YTIPTE,
C      1 XF(NF),YF(NF)
C      WRITE(6,11)ALFAC,PHI
C      IF (MOUT.NF.0) WRITE (6,DEBUG)
C
C      READ NUMBERS OF WING LEADING EDGE VORTEX INFO STATIONS XLE FOR
C      EACH WING.
C      FOR EACH XLE STATION, READ IN YBAR AND STRENGTH OF THE VORTICITY
C      DISTRIBUTION.
C
C      NOTE: XLE AND XSE ARE READ IN IN THE WING COORDINATE SYSTEM AND
C      MUST BE TRANSFORMED TO BODY COORDINATE SYSTEM.
C
C      READ (5,4) NSWR,MSWL
C      NEDGV=MSWR+MSWL
C      IF (NEDGV.EQ.0) GO TO 19
C      READ (5,7) (XLE(IFV),CGLOC(IFV),GAMLE(IFV),
C      1 IFV=1,NEDGV)
C      WRITE (6,706)
C      DO 15 JLE=1,NEDGV
C      XLE(JLE)=XLE(JLE)+XF(1)
C      15 WRITE (6,705) JLE,XLE(JLE),CGLOC(JLE),GAMLE(JLE)
C      19 CONTINUE
C
C      READ NUMBER OF WING SIDE EDGE VORTEX INFO STATIONS XSE FOR EACH
C      WING.
C      FOR EACH XSE STATION, READ IN YBAR AND STRENGTH OF THE VORTICITY
C      DISTRIBUTION.
C
C      READ (5,4) NSCW
C      NSIDGE=2*NSCW
C      IF (NSIDGE.EQ.0) GO TO 18
C      READ (5,7) (XSE(JSE),CGSELC(JSE),GAMSE(JSE),
C      1 JSE=1,NSIDGE)
C      WRITE (6,707)
C      DO 16 JSE=1,NSIDGE
C      XSE(JSE)=XSE(JSE)+XF(1)
C      16 WRITE (6,705) JSE,XSE(JSE),CGSELC(JSE),GAMSE(JSE)
C      18 CONTINUE
C
C      NOTE: HERE RLOC.....,HORIZONTAL SEMI-AXIS.
C      BLOC.....,VERTICAL SEMI-AXIS.
C
C      WRITE (6,700) ES
C      WRITE (6,25)
C      WRITE(6,26)XIP(1)
C      CALL SHAPE (XIP(1),RLOC,BLOC,SLUC,WPLOC)
C      WRITE (6,9) RLOC,BLOC,SLUC
C      WRITE(6,27)
C      WRITE(6,22)(L,VX(L),VY(L),G(L),L=1,NV)
C
C      CONVERT ANGLES TO RADIAN
C
C      AC=ALFAC*PI/180

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VPL01190  
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VPL01252

	RE=PHI*RAD	VPL01253
	PHI=RE	VPL01254
	AL=ASIN(SIN(AC)*COS(RE))	VPL01255
	RE=ASIN(SIN(AC)*SIN(RE))	VPL01256
C	.....COMPUTE VORTEX PATHS USING DASCRO INTEGRATION SUBROUTINE.....	VPL01257
C		VPL01258
C		VPL01259
	NIPI=NIPI-1	VPL01260
	H=XIP(2)-XIP(1)	VPL01261
	DO 20 I=1,NIPI	VPL01262
	I1=I+1	VPL01263
	NV=NVV(I)	VPL01264
	NVN=NVV(I1)	VPL01265
	NV1=NV+1	VPL01266
	N=2*NV	VPL01267
	A1=XIP(I)	VPL01268
	R1=XIP(I+1)	VPL01269
C		VPL01270
	CALL DASCRO(A1,B1,H,N,X0,K,IER,ES,VRTMAX)	VPL01271
C		VPL01272
C	IF IER GREATER THAN 32,DASCRO HAD TROUBLE GETTING STEP SIZE,	VPL01273
C	THEN, RATHER THAN CONTINUING WITH THE INTEGRATION, STOP 40	VPL01274
C	REDUCE XIP(2)=XIP(1) AND RERUN	VPL01275
C		VPL01276
	IF (IER,GE,32) GO TO 28	VPL01277
	GO TO 29	VPL01278
	28 WRITE (6,701)	VPL01279
	STOP 40	VPL01280
	29 CONTINUE	VPL01281
C		VPL01282
C		VPL01283
C	.. ADD THE NEW VORTICES AND THEIR POSITIONS FOR THE NEXT X-INTERVAL	VPL01284
C		VPL01285
	IF(NVN,EO,NV)GO TO 39	VPL01286
	DO 35 K1=NV1,NVN	VPL01287
	JL=2*K1-1	VPL01288
	KK=JL+1	VPL01289
	X0(JL)=VX(K1)	VPL01290
	35 X0(KK)=VY(K1)	VPL01291
	39 CONTINUE	VPL01292
C		VPL01293
C	.. OUTPUT VORTEX POSITIONS AND CONFIGURATION CHARACTERISTICS AT THIS	VPL01294
C	STATION.	VPL01295
C		VPL01296
	WRITE(6,21)I1,R1,H	VPL01297
	CALL SHAPE (B1,PLUC,BLOC,SLUC,WPLUC)	VPL01298
	WRITE (6,9) RLOC,BLOC,SLUC	VPL01299
C		VPL01300
C	SAVE BODY POINTS FOR PLOT	VPL01301
C		VPL01302
	XPLT(1,I1)=X1	VPL01303
	YPLT(1,I1)=PLUC	VPL01304
	ZPLT(1,I1)=BLOC	VPL01305
	YPLT(2,I1)=SLUC	VPL01306
	WRITE(6,27)	VPL01307
	DO 23 L=1,NVN	VPL01308
	J=2*L-1	VPL01309
	K=J+1	VPL01310
	VXP(1,L,1)=X0(J)	VPL01311
	VXP(1,L,2)=X0(K)	VPL01312
	WRITE(6,22)L,X0(J),X0(K),R(L)	VPL01313
C		VPL01314
C	SAVE VORTEX LOCATION FOR PLOT	VPL01315



C	JCV=NIP1+L+1	VPL01316
	XPLT(I,JCV)=B1	VPL01317
	YPLT(I,JCV)=XIP(J)	VPL01318
	ZPLT(I,JCV)=XO(K)	VPL01319
23	CONTINUE	VPL01320
20	CONTINUE	VPL01321
C		VPL01322
C	PLOT VORTEX LOCATIONS	VPL01323
C		VPL01324
	XPLT(1,1)=XIP(1)	VPL01325
	IF (IPLT,GT,0)	VPL01326
	* CALL PLOTVB(XPLT,YPLT,ZPLT,NPLT,NIP1,NVN,30,ROT,XE,YE,WF,XP2,YP2,IPLT)	VPL01327
		VPL01328
		VPL01329
C		VPL01330
C	COMPUTE VELOCITIES AT THE SPECIFIED CONTROL POINTS INDUCED BY NV	VPL01331
C	EXTERNAL VORTICES AND THEIR IMAGES.	VPL01332
C		VPL01333
C		VPL01334
C	NOTE: IF CONTROL POINTS ARE PASSED THROUGH BY MEANS OF A DATA SET	VPL01335
C	I.E. WHEN NCPIN IS NOT EQUAL TO 0, INDEX NCP IS READ IN FROM	VPL01336
C	THE DATA SET ALSO.	VPL01337
C	NOTE: X=COORDINATE OF CONTROL POINT MUST THEN BE TRANSFORMED TO BODY	VPL01338
C	COORDINATE SYSTEM.	VPL01339
C	THIS IS DONE BELOW.	VPL01340
C		VPL01341
C		VPL01342
	NCP=0	VPL01343
	IF (NCPIN,NE,0) REWIND 4	VPL01344
	IF (NVLOUT,NE,0) REWIND 7	VPL01345
	IF (NCPIN,EQ,0) GO TO 72	VPL01346
	IF (NCPIN,NE,0) READ (4,745) NCP	VPL01347
	IF (EOF(4),NE,0) GO TO 99	VPL01348
	GO TO 73	VPL01349
72	READ (5,4) NCP	VPL01350
73	CONTINUE	VPL01351
	IF (NCP,EQ,0) GO TO 99	VPL01352
	WRITE(6,31)	VPL01353
	DO 69 J1=1,NCP	VPL01354
	IF (NCPIN,EQ,0) GO TO 70	VPL01355
	READ (4,745) IC,CPX,CPY,CPZ	VPL01356
	CPX=CPX+XF(1)	VPL01357
	GO TO 71	VPL01358
70	READ(5,60)CPX,CPY,CPZ	VPL01359
71	CONTINUE	VPL01360
C		VPL01361
C	DETERMINE THE X-STATIONS ADJACENT TO THE CONTROL POINT	VPL01362
C		VPL01363
	DO 61 I=1,NIP	VPL01364
	IF (CPX,LT,XIP(1)) GO TO 69	VPL01365
	J=1-1	VPL01366
	IF (I,EQ,1) J=1	VPL01367
	IF (CPX,LE,XIP(I)) GO TO 62	VPL01368
61	CONTINUE	VPL01369
C		VPL01370
C	DETERMINE BY INTERPOLATION THE POSITION IN THE CROSSFLOW PLANE OF ALL	VPL01371
C	VORTICES AT EACH STATION CPX.	VPL01372
C		VPL01373
62	K=J+1	VPL01374
	X1=XIP(J)	VPL01375
	X2=XIP(K)	VPL01376
	WT1=(X2-CPX)/(X2-X1)	VPL01377
	WT2=(CPX-X1)/(X2-X1)	VPL01378

```

NV=NVV(J)
CALL SHAPE (CPX,HB,HL,SL,RPL)
IF (NOUT.EQ.0) WRITE (A,703)
DO 63 I=1,NV
  VX(I)=T1*VXP(J,I,1)+T2*VXP(K,I,1)
  VY(I)=T1*VXP(J,I,2)+T2*VXP(K,I,2)
  IF (NOUT.EQ.0) GO TO 63
  WRITE (A,702) I,VX(I),VY(I)
63 CONTINUE

  THETP=ATAN2(CPZ,CPY)
  SINTH=SIN(THETP)
  CUSTH=COS(THETP)
  RCPT=SQRT(CPY*CPY+CPZ*CPZ)
  RHODY=SQRT(1.0/((SINTH/RL)**2+(CUSTH/RB)**2))
  IF (RCPT.LE.RHODY) GO TO 64
  GO TO 65
64 RHODYP=1.01*RHODY
  CPY=RHODYP*CUSTH
  CPZ=RHODYP*SINTH
65 CONTINUE

SUBROUTINE VVELS CALCULATES VELOCITIES INDUCED BY EXTERNAL
VORTICES AROUND ELLIPTICAL CROSS SECTION BODY BY SETTING S=RB IN
THE ARGUMENT LIST.

CALL VVELS(NV,CPY,CPZ,VX,VY,G,HB,SL,RB,V,W,VNTHAX)
WRITE(A,32) J11,CPX,CPY,CPZ,V,X
IF (NVLOUT.EQ.0) GO TO 69
IC=J11
WRITE (7,746) IC,CPX,CPY,CPZ,V,X
69 CONTINUE
GO TO 99
2 STOP
END

```

SUBROUTINE DASCRO (A,B,M,N,X0,X1,IER,E5,VNTHAX)

THIS SUBROUTINE PERFORMS INTEGRATION

E5 SHOULD BE SET TO .5 TIMES THE  
DESIRED RELATIVE PRECISION OF  
THE SOLUTION

DIMENSION WK(1),X0(1)

INTEGER SW

LOGICAL HE,HH,HR,HX

DATA ZERO,PS,CPS,THREE,FOUR/0.,.5,1.5,3.,4./

IER = 0

IF (A = B) A=100.4

4 I41=N+N

I42=I41+N

WMIN=0.01\*ABS(M)

VPL02 1  
VPL02 2  
VPL02 3  
VPL02 4  
VPL02 5  
VPL02 6  
VPL02 7  
VPL02 8  
VPL02 9  
VPL02 10  
VPL02 11  
VPL02 12  
VPL02 13  
VPL02 14  
VPL02 15  
VPL02 16  
VPL02 17  
VPL02 18  
VPL02 19  
VPL02 20  
VPL02 21

```

RHS,TRUE.
HRS,TRUE.
HXS,TRUE.

```

CHECK FOR THE PROPER SIGN OF H

```

M=SIGN(ARS(H),H-A)
XEA
5 XS=X
  DO 10 J=1,N
    IJK0=N+J
    WK(IJK0)=X0(J)
10 CONTINUE
15 HS=M
  Q=X+H-R
  RES,TRUE.
  IF(.NOT.((H.GT.ZERO.AND.Q.GE.ZERO).OR.(H.LT.ZERO.AND.Q.LE.ZERO)))
  1 GO TO 20
  H=H-X
  RES,FALSE.
20 HS=M/THREE

```

CALCULATE SOLN. AT X+H

NOTE: ARRAY WK CONTAINS V FOR ODD INDEX, W FOR EVEN INDEX.

```

DO 90 S=1,5
  CALL F(X0,X,N,WK,VOTMAX)
  DO 70 I=1,N
    Q=H3+WK(I)
    IJK0=N+I
    IJK1=I+1
    IJK2=I+2
    GO TO (25,30,35,40,45),S
25 R=Q
    WK(IJK1)=Q
    GO TO 50
30 Q=5*(Q+WK(IJK1))
    GO TO 50
45 R=THREE*Q
    WK(IJK2)=R
    R=.375*(R+WK(IJK1))
    GO TO 50
40 R=WK(IJK1)+FOUR*Q
    WK(IJK1)=R
    R=5*(R-WK(IJK2))
    GO TO 50
45 R=5*(Q+WK(IJK1))
    Q=ARS(R+R - 5*(Q+WK(IJK2)))
50 X0(I)=WK(IJK0)+R
    IF(S=4E,5) GO TO 70

```

AUTOMATIC STEP CHANGE

```

E=ARS(X0(I))
R=E5
IF(E,GE,1,E=3) W=E+E5

```

TEST ADJUSTMENT OF THE STEP

```

IF(G.LT,P,OR.(.NOT.HX)) GO TO 65
HRS,TRUE.
HXS,FALSE.

```

	H=PS*M	VPL02 85
	IF(AHS(H),GE,HMIN) GO TO 55	VPL02 86
C		VPL02 87
C	THE STEP IS HALVED RESTORE X AND X0,	VPL02 88
C	AND GO BACK FOR REPEATED INTEGRATION	VPL02 89
C	WITH THIS NEW STEP	VPL02 90
		VPL02 91
	H=SIGN(1,H)*HMIN	VPL02 92
	RES,FALSE	VPL02 93
55	DO 60 I=1,N	VPL02 94
	IJKO=H+J	VPL02 95
	X0(J)=X(IJKO)	VPL02 96
60	CONTINUE	VPL02 97
	X=X8	VPL02 98
	GO TO 15	VPL02 99
65	IF(0,GE,0.03125*R) RES,FALSE	VPL02100
70	CONTINUE	VPL02101
	GO TO (75,90,80,85,90),8H	VPL02102
75	X=X+H3	VPL02103
	GO TO 90	VPL02104
80	X=X+P5+H3	VPL02105
	GO TO 90	VPL02106
85	X=X+P5+H	VPL02107
90	CONTINUE	VPL02108
C		VPL02109
C	TEST A POSSIBLE DOUBLING OF THE STEP	VPL02110
C		VPL02111
	IF(.NOT.(HE.AND,BH.AND,HR)) GO TO 95	VPL02112
	H=H+H	VPL02113
	H=TRUE	VPL02114
95	H=TRUE	VPL02115
	IF(HR) GO TO 5	VPL02116
	H=H8	VPL02117
	IF(HX,OR,HE) GO TO 9005	VPL02118
	IFR = 33	VPL02119
	GO TO 9005	VPL02120
100	DO 105 I=1,N	VPL02121
	X0(I)=ZERO	VPL02122
105	CONTINUE	VPL02123
9005	RETURN	VPL02124
	END	VPL02125

	COMPLEX FUNCTION DBLU(Z)	VPL03 1
C		VPL03 2
C	THIS FUNCTION SUBROUTINE CALCULATES THE INTERMEDIATE TRANSFORM	VPL03 3
C	VARIABLE W FOR THE CONFORMAL TRANSFORMATION OF AN ELLIPTICAL	VPL03 4
C	BODY WITH KINGS TO A CIRCLE.	VPL03 5
C		VPL03 6
	COMMON/COM1/A2,B2,R2	VPL03 7
	COMMON/COM3/ZR,ZI	VPL03 8
	COMMON/COM5/U=0Z	VPL03 9
	COMMON/COM6/*2,*	VPL03 10
	COMMON/PARAM/NOU	VPL03 11
C		VPL03 12
	COMPLEX Z,Z2,0=0Z,*2,*	VPL03 13
C		VPL03 14
700	FORMAT (/19X,2H22,22X,4H0=0Z/14X,2HRE,9X,2HIM,11X,2HRE,9X,2HIM)	VPL03 15
701	FORMAT (10X,F10.5,1X,F10.5,2X,F10.5,1X,F10.5)	VPL03 16
C		VPL03 17

C	IF (NOUT.EQ.2) WRITE (6,700)	VPL03 18
	Z2=Z*Z	VPL03 19
	ZR=REAL(Z)	VPL03 20
	ZI=AIMAG(Z)	VPL03 21
	IF(ZR.NE.0.0) ZR=ZR/ABS(ZR)	VPL03 22
	IF(ZI.NE.0.0) ZI=ZI/ABS(ZI)	VPL03 23
	Z2=ZR+R2	VPL03 24
	IF (NOUT.EQ.2) WRITE (6,701) Z2	VPL03 25
	V=AIMAG(Z2)	VPL03 26
	AV=1.0	VPL03 27
	IF(V.LT.0.0) AV=-1.0	VPL03 28
	AVZ=1.0	VPL03 29
	IF(ZI.LT.0.0) AVZ=-1.0	VPL03 30
	Z2=CSQRT(Z2)*AV*AVZ	VPL03 31
	IF (NOUT.EQ.2) WRITE (6,701) Z2	VPL03 32
	IF((ABS(ZI).LE.0.0).AND.(REAL(ZI).LT.0.0)) Z2=CMPLX(-REAL(Z2),	VPL03 33
	1 AIMAG(Z2))	VPL03 34
	DWDZ=0.5*(1.0+Z/Z2)	VPL03 35
	IF (NOUT.EQ.2) WRITE (6,701) Z2,DWDZ	VPL03 36
	WW=0.5*(Z+Z2)	VPL03 37
	*2=1.0/(WW*WW)	VPL03 38
	DPLU=WW	VPL03 39
	RETURN	VPL03 40
	END	VPL03 41
		VPL03 42

C	COMPLEX FUNCTION DSQZ(S)	VPL04 1
C	CALCULATE DZETA/DTAU	VPL04 2
C	COMMON/COM2/SIG2,H2	VPL04 3
	COMMON/COM5/D+DZ	VPL04 4
	COMMON/COM4/G2,G1	VPL04 5
	COMMON/COM6/*2,*	VPL04 6
	COMPLEX *2,DWDZ,G1,G2	VPL04 7
	DSQZ=0.5*(1.0+SIG2*2)*(1.0+G1/G2)*DWDZ	VPL04 8
	RETURN	VPL04 9
	END	VPL04 10
		VPL04 11
		VPL04 12

C	COMPLEX FUNCTION DZOS(S)	VPL05 1
C	CALCULATE DZ/DZETA	VPL05 2
C	COMMON/COM1/A2,H2,H2	VPL05 3
	COMMON/COM2/SIG2,H2	VPL05 4
	COMMON/COM6/*2,*	VPL05 5
	COMPLEX *2,S,*2,G1,S2,7,Z2	VPL05 6
	S2=S*S	VPL05 7
	G1=0.5*(1.0+0.25*(A2+H2)*2)*(1.0+R2/S2)	VPL05 8
	Z=S+R2/S	VPL05 9
	Z2=Z*Z+4.0*SIG2	VPL05 10
	V=AIMAG(Z)	VPL05 11
	VZ=AIMAG(Z2)	VPL05 12
	AV=1.0	VPL05 13
	AVZ=1.0	VPL05 14
		VPL05 15
		VPL05 16

IF(Y.LT.0.0) AY=-1.0	VPL05 17
IF(YZ.LT.0.0) AYZ=-1.0	VPL05 18
ZZ=CSQRT(ZZ)*AY*AYZ	VPL05 19
IF((ABS(Y).LE.0.0).AND.(REAL(Z).LT.0.0)) ZP=CMPLX(-REAL(ZZ),	VPL05 20
1 AIMAG(ZZ))	VPL05 21
DZDS=G1*(1.0+Z/ZZ)	VPL05 22
RETURN	VPL05 23
END	VPL05 24

C	COMPLEX FUNCTION DZSDZ2(S)	VPL06 1
C		VPL06 2
C	CALCULATE DZETA2/DZ2	VPL06 3
C		VPL06 4
	COMMON/COM2/SIG2,H2	VPL06 5
	COMMON/COM4/G2,G1	VPL06 6
	COMMON/COM6/H2,*	VPL06 7
	COMMON/COM5/DW0Z	VPL06 8
	COMPLEX W,H2,DW0Z,G2,G1	VPL06 9
	DZSDZ2=(1.0+G1/G2)*SIG2*W2/*	VPL06 10
	DZSDZ2=DZSDZ2-0.5*(1.0-SIG2*W2)*(1.0-SIG2*W2)+H2/(G2*(G1+G1-H2))	VPL06 11
	DZSDZ2=DZSDZ2*DW0Z*DW0Z	VPL06 12
	RETURN	VPL06 13
	END	VPL06 14

C	SUBROUTINE EXPAND(RP,Y,Y,VS,*S)	VPL07 1
C		VPL07 2
C	THIS SUBROUTINE CALCULATES VELOCITIES INDUCED BY EXPANDING OR	VPL07 3
C	CONTRACTING ELLIPTICAL CROSS SECTION.	VPL07 4
C		VPL07 5
	COMMON/COM1/A2,H2,H2	VPL07 6
	COMMON/BLK1/A,R,S,P1,C1	VPL07 7
	COMMON/COM8/HFACT	VPL07 8
	COMPLEX VE,Z,ZI,C1	VPL07 9
	SP=HFACT*A*RP	VPL07 10
	Z=CMPLX(X,Y)	VPL07 11
	ZI=Z*Z	VPL07 12
	AY=1.0	VPL07 13
	IF(AIMAG(Z).LT.0.0) AY=-1.0	VPL07 14
	AYZ=1.0	VPL07 15
	IF(AIMAG(ZI).LT.0.0) AYZ=-1.0	VPL07 16
	Z=CSQRT(ZI-A2+H2)*AY*AYZ	VPL07 17
	IF((ABS(AIMAG(Z)).LE.0.0).AND.(REAL(Z).LT.0.0))	VPL07 18
1	Z=CMPLX(-REAL(Z),AIMAG(Z))	VPL07 19
	VE=SP/Z	VPL07 20
	VS=REAL(VE)	VPL07 21
	-S0=AIMAG(VE)	VPL07 22
	RETURN	VPL07 23
	END	VPL07 24

SUBROUTINE F(XO,PX,N,WK,VRTMAX)	VPL08	1
C	VPL08	2
C THIS SUBROUTINE IS CALLED BY DASCRO TO CALCULATE CROSS FLOW	VPL08	3
C PLANE VELOCITIES	VPL08	4
C	VPL08	5
COMMON/VEL/AL,RE, -VX(30),VY(30),G(30),WV, NS,NF,	VPL08	6
IXE(7),XF(7),YF(7),C(7,7),IFIN	VPL08	7
COMMON/BLK1/A,R,S,PI,CI	VPL08	8
COMMON/BLK2/AC,PHI	VPL08	9
COMMON/FINLE/YLF(80),CGLOC(80),GAMLE(80),MS=H,MSWL,MSWU,MSWD,	VPL08	10
1 AEOGV,XTIPE	VPL08	11
COMMON/SIDE06/XSE(80),CGSELC(80),GAMSE(80),HCV,NSIGGE,XTIPE	VPL08	12
COMMON/COM1/A2,H2,R2	VPL08	13
COMMON/COM2/SIG2,H2	VPL08	14
COMMON/COM7/B	VPL08	15
COMMON/COM9/IGROW	VPL08	16
COMMON/PARAM/NOOT	VPL08	17
C	VPL08	18
DIMENSION XO(1),WK(1),V(30),W(30),VV(30),WW(30)	VPL08	19
C	VPL08	20
C	VPL08	21
C	VPL08	22
EXTERNAL Z,FCT,SIMP	VPL08	23
C	VPL08	24
NAMELIST/DEBUG/X,Y,YVINT,ZVBAR,GAMINT,A,H,VRTMAX,VS,WS	VPL08	25
C	VPL08	26
CI=CMPLX(0.,1.)	VPL08	27
PI=3.14159265	VPL08	28
DO 888 I=1,NV	VPL08	29
J=2*I-1	VPL08	30
K=J+1	VPL08	31
VX(I)=XO(J)	VPL08	32
888 VY(I)=XO(K)	VPL08	33
CALL SHAPE(PX,A,d,S,WP)	VPL08	34
C	VPL08	35
C NOTE: COORDINATE VX(I) IS THE Y-COORDINATE IN THE CROSS FLOW PLANE.	VPL08	36
C COORDINATE VY(I) IS THE Z-COORDINATE IN THE CROSS FLOW PLANE.	VPL08	37
C	VPL08	38
C COMPUTE VELOCITIES IN THE CROSSFLOW PLANE ...	VPL08	39
C V(I) IS IN THE Y-DIRECTION.	VPL08	40
C W(I) IS IN THE Z-DIRECTION.	VPL08	41
C	VPL08	42
C	VPL08	43
A2=A*A	VPL08	44
H2=H*H	VPL08	45
APH=A*H	VPL08	46
APH2=APH*APH	VPL08	47
R1=S+SQRT(S*S+A2+H2)	VPL08	48
W=0.25*(R1+APH2/R1)	VPL08	49
H=H+R	VPL08	50
H2=H*H	VPL08	51
SIG=0.5*APH	VPL08	52
SIG2=SIG*SIG	VPL08	53
R2=R*R	VPL08	54
DO 100 I=1,NV	VPL08	55
X=VX(I)	VPL08	56
Y=VY(I)	VPL08	57
VS=0.	VPL08	58
WS=0.	VPL08	59
C	VPL08	60
C COMPUTE VELOCITIES IN CROSS FLOW PLANE DUE TO ANGLE OF PITCH AND	VPL08	61
C ANGLE OF SIDESLIP.	VPL08	62
C	VPL08	63

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      IF (NOUT.EQ.3) WRITE (6,DEHUG)
      IF ((AL.NE.0.0).OR.(HE.NE.0.0)) CALL PITNOL(AL,HE,X,Y,VS,VS)
      IF (NOUT.EQ.3) WRITE (6,DEHUG)
      V(I)=VS
      A(I)=AS
C
C   COMPUTE VELOCITIES IN CROSSFLOW PLANE DUE TO EXPANDING BODY
C
      VS=0.0
      AS=0.0
      IF (IGROW.GT.0) CALL EXPAND(RP,X,Y,VS,AS)
      IF (NOUT.EQ.3) WRITE (6,DEHUG)
      V(I)=V(I)+VS
      A(I)=A(I)+AS
C
C   IF WING LE VORTICITY IS INCLUDED, DETERMINE BY INTERPOLATION THE
C   EFFECTS OF THE SPECIFIED VORTICITY.
C
C   NOTE: HERE IFIN=1....RIGHT WING
C         IFIN=2....LEFT WING
C
      IF (NEDGV.EQ.0) GO TO 20
      IFIN=1
      KSTART=1
      KUL=MSWR
23 CONTINUE
      IF (IFIN.EQ.2) KSTART=MSWR+1
      DO 21 IFV=KSTART,KUL
      IF (PX,LT,XLE(KSTART)) GO TO 20
      JV=IFV-1
      IF (IFV.EQ.1) JV=1
      IF (PX,LE,XLE(IFV)) GO TO 22
24 CONTINUE
      IF (PX,LE,X(TIPL)) GO TO 34
      GO TO 20
22 KV=JV+1
      X1=XLE(JV)
      X2=XLE(KV)
      T1=(X2-PX)/(X2-X1)
      T2=(PX-X1)/(X2-X1)
      YVINT=T1*CGLOC(JV)+T2*CGLOC(KV)
      ZVBAR=(PX-XF(1))*TAN(AL/2.0)
      GAMINT=T1*GAMLE (JV)+T2*GAMLE (KV)
      IF (NOUT.EQ.3) WRITE (6,DEHUG)
      GO TO 39
38 GAMINT=GAMLE(KUL)
      YVINT=CGLOC(KUL)
      ZVBAR=(PX-XF(1))*TAN(AL/2.0)
      IF (NOUT.EQ.3) WRITE (6,DEHUG)
39 CALL VVEL9(1,X,Y,YVINT,ZVBAR,GAMINT,A,B,S,VS,AS,VRT,AY)
      IF (NOUT.EQ.3) WRITE (6,DEHUG)
      V(I)=V(I)+VS
      A(I)=A(I)+AS
      IFIN=IFIN+1
      IF (IFIN.GT.2) GO TO 20
      KUL=MSR+MSAL
      GO TO 23
20 CONTINUE
C
C
C   IF WING SE VORTICITY IS INCLUDED, DETERMINE BY INTERPOLATION THE
C   EFFECTS OF THE SPECIFIED VORTICITY.
C

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VPL08 64
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VPL08126

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IF (NSIDGE.EQ.0) GO TO 28                                VPL08127
IFIN=1                                                    VPL08128
KSTART=1                                                  VPL08129
KUL=NCW                                                  VPL08130
27 CONTINUE                                              VPL08131
IF (IFIN.EQ.2) KSTART=NCW+1                             VPL08132
DO 29 JSE=KSTART,KUL                                    VPL08133
IF (PX.LT.XSE(KSTART)) GO TO 28                         VPL08134
JVSE=JSE-1                                              VPL08135
IF (JSE.EQ.1) JVSE=1                                    VPL08136
IF (PX.LE.XSE(JSE)) GO TO 30                            VPL08137
29 CONTINUE                                              VPL08138
IF (PX.LE.XTIPT) GO TO 51                               VPL08139
GO TO 28                                                 VPL08140
30 KVSE=JVSE+1                                           VPL08141
X1=XSE(JVSE)                                           VPL08142
X2=XSE(KVSE)                                           VPL08143
WT1=(X2-PX)/(X2-X1)                                     VPL08144
WT2=(PX-X1)/(X2-X1)                                     VPL08145
YVINT=WT1*CGSELC(JVSE)+WT2*CGSELC(KVSE)               VPL08146
ZVRAR=(PX-XF(1))*TAN(AL/2.0)                           VPL08147
GAMINT=WT1*GAMSE(JVSE)+WT2*GAMSE(KVSE)                VPL08148
IF (NOUT.EQ.5) WRITE (6,DEBUG)                          VPL08149
GO TO 59                                                 VPL08150
51 GAMINT=GAMSE(KUL)                                    VPL08151
YVINT=CGSELC(KUL)                                       VPL08152
ZVRAR=(PX-XF(1))*TAN(AL/2.0)                            VPL08153
IF (NOUT.EQ.3) WRITE (6,DEBUG)                          VPL08154
59 CALL VVELS(1,X,Y,YVINT,ZVRAR,GAMINT,A,B,S,VS,S,VRTMAX) VPL08155
IF (NOUT.EQ.5) WRITE (6,DEBUG)                          VPL08156
V(1)=V(1)+VS                                           VPL08157
W(1)=W(1)+WS                                           VPL08158
IFIN=IFIN+1                                             VPL08159
IF (IFIN.GT.2) GO TO 28                                VPL08160
KUL=2+KUL                                              VPL08161
GO TO 27                                                VPL08162
28 CONTINUE                                              VPL08163
100 CONTINUE                                             VPL08164
C 101 CONTINUE                                           VPL08165
C CALCULATE VELOCITIES INDUCED BY ALL VORTICES ON ONE VORTEX IN THE VPL08166
C PRESENCE OF AN ELLIPTICAL BODY=MONOPLANE WING.      VPL08167
C 102 CALL VVTEX(MV,VX,VY,G,VV,WW)                    VPL08168
C LOCAL=COS(AC)                                         VPL08169
DO 101 I=1,MV                                           VPL08170
V(I)=V(I)+VV(I)                                         VPL08171
W(I)=W(I)+VV(I)                                         VPL08172
J=2*I-1                                                 VPL08173
K=J+1                                                    VPL08174
WK(J)=V(I)/CAL                                          VPL08175
WK(K)=W(I)/CAL                                          VPL08176
101 CONTINUE                                             VPL08177
RETURN                                                  VPL08178
END                                                    VPL08179

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SUBROUTINE PITPOL(AL,RE,X,Y,VS,WS)

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C THIS SUBROUTINE COMPUTES THE CROSSFLOW COMPONENTS FOR A WINGED VPL09 1
C ELLIPTICAL BODY AT ANGLE OF ATTACK,AL, AND SIDESLIP ANGLE,SE. VPL09 2
C COMMON/BI X1/4,R,S,PI,C1 VPL09 3
C VPL09 4
C VPL09 5
C VPL09 6

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COMPLEX SZ,CI,ZA,SO,SQS,VELAL,Z,OSDZ	VPL09 7
EXTERNAL Z,OSDZ	VPL09 8
RR=RR*P	VPL09 9
ZA=CMPI X(X,Y)	VPL09 10
SZ=Z(ZA)	VPL09 11
SQ=SZ*SZ	VPL09 12
SQS=OSDZ(ZA)	VPL09 13
VELAL=CMPLX(0,0,0,0)	VPL09 14
IF(AL,NE,0,0) VELAL=-CI*SIGN(AL)*(1,0+RR/SQ)+SQS+VELAL	VPL09 15
IF(HE,NE,0,0) VELAL=VELAL-SIGN(HE)*(1,0-RR/SQ)+SQS	VPL09 16
VS=REAL(VELAL)	VPL09 17
VS=-4*IMAG(VELAL)	VPL09 18
RETURN	VPL09 19
END	VPL09 20
SUBROUTINE PLOTVB(X,Y,Z,NP,NIP1,NVN,NOP,ROT,XP,YF,NF,X2,Y2,IORT)	VPL10 1
C	VPL10 2
C ROUTINE TO GENERATE A PLOT VERTEX LOCATION RELATIVE TO	VPL10 3
C THE WING-BODY CONFIGURATION	VPL10 4
C DEFINITIONS:	VPL10 5
C NC = INDEX OF CURVE	VPL10 6
C NIP1 = NO. OF BODY STATIONS	VPL10 7
C NVN = NO. OF VERTICES	VPL10 8
C NF = NO. OF WING DEFINITION CARDS	VPL10 9
C	VPL10 10
DIMENSION X(NOP,52),Y(NOP,52),Z(NOP,52)	VPL10 11
DIMENSION NP(52),ROT(3),XCG(3),XF(7),YF(7)	VPL10 12
DIMENSION X2(17,18),Y2(17,18),P2(18),SYMBOL(40)	VPL10 13
C	VPL10 14
DATA SYMBOL / 1H*,1H*,1H*,1H*,1H*,1H1,1H2,1H3,1H4,1H5,1H6,	VPL10 15
* 1H7,1H8,1H9,1HA,1HR,1RC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ,1HK,1HL,	VPL10 16
* 1HM,1HN,1HO,1HP,1HQ,1HR,1HS,1HT,1HU,1HV,1HW,1HX,1HY,1HZ/	VPL10 17
C	VPL10 18
LENG AND LWD: GIVE A PLOT THAT IS 9"x10"	VPL10 19
DATA LWD,LENG,XCG/ 100,54, 0.,0.,0./	VPL10 20
IF (IORT,LE,0) IORT=3	VPL10 21
C	VPL10 22
1HG WRITTEN HERE IS TO SUPPRESS THE AUTOMATIC PAGE EJECT	VPL10 23
WRITE(6,10)	VPL10 24
WRITE(6,11)	VPL10 25
10  FORMAT(1H1)	VPL10 26
11  FORMAT(1H9)	VPL10 27
C	VPL10 28
C FIND MAXIMUM DIAMETER	VPL10 29
C	VPL10 30
RMAX=0.	VPL10 31
DO 100 I=1,NIP1	VPL10 32
100  RMAX=MAX1(RMAX,Y(I,I+1),Z(I,I+1))	VPL10 33
C	VPL10 34
C CURVE 1: DRAW AXES	VPL10 35
C	VPL10 36
NC=1	VPL10 37
DO 120 I=1,5	VPL10 38
X(I,1)=X(1,1)	VPL10 39
Y(I,1)=0.	VPL10 40
120  Z(I,1)=0.	VPL10 41
X(2,1)=X(1,NIP1+1)	VPL10 42
Y(4,1)=1.5*RMAX	VPL10 43
Z(6,1)=1.5*RMAX	VPL10 44
NP(1)=6	VPL10 45
C	VPL10 46
C CURVES: 2 TO NIP1+1	VPL10 47
C GENERATE CROSS SECTIONS	VPL10 48

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C
NGV=NIP1+NVN+5
MERID=17
DO 160 J=1,NIP1
NC=NC+1
R1=X(1,NC)
RLOC=Y(1,NC)
RLOC=Z(1,NC)
SLOC=Y(2,NC)
C SAVE RLOC AND BLOC
Y(J,NGV)=RLOC
Z(J,NGV+1)=RLOC
Y(J,NGV+2)=SLOC
C
C GENERATE ELLIPTIC BODY CROSS SECTION
C
UTH=2.431415926/(MERID=1)
DO 140 I=1,MERID
PHI=(I-1)*UTH
RAD=(COS(PHI)/RLOC)**2+(SIN(PHI)/RLOC)**2
RAD=SQRT(1./RAD)
Y(I,NC)=RAD*SIN(PHI)
Z(I,NC)=RAD*COS(PHI)
X(I,NC)=R1
140 CONTINUE
160 MP(NC)=MERID
C
C PLOT VORTEX LOCATION (ALREADY DEFINED)
C
DO 170 I=1,NVN
NC=NC+1
170 MP(NC)=NIP1
C
C DRAWING OUTLINE
C
IF (NF.LE.0) GO TO 200
DO 190 J=1,2
NC=NC+1
SGN=(-1)**(J+1)
DO 180 I=1,NF
X(I,NC)=XF(I)
Y(I,NC)=YF(I)*SGN
Z(I,NC)=0.0
180 CONTINUE
NF=NF+1
X(NF1,NC)=XF(1)
Y(NF1,NC)=YF(1)*SGN
Z(NF1,NC)=0.0
MP(NC)=NF1
190 CONTINUE
200 CONTINUE
C
C PLOT CROSS SECTIONS WITH VORTEX LOCATIONS
C
DO 240 ISECTN=1,5
IF (ISECTN.EQ.1) JSECTN=1
IF (ISECTN.EQ.2) JSECTN=NIP1/2
IF (ISECTN.EQ.3) JSECTN=NIP1
C
C COPY BODY
C
DO 220 I=1,MERID
X2(I,1)=Y(I,JSECTN+1)

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VPL10109

Y2(1,1)=Z(1,JSECTN+1)	VPL10110
220 CONTINUE	VPL10111
NP2(1)=NPERID	VPL10112
NC2=1	VPL10113
C	VPL10114
C DRAWING OUTER BOUNDARIES	VPL10115
C	VPL10116
SLGC=Y(JSECTN,NGV+2)	VPL10117
X2(1,2)=SLGC	VPL10118
Y2(1,2)=0.	VPL10119
X2(2,2)=-SLGC	VPL10120
Y2(2,2)=0.	VPL10121
NP2(2)=2	VPL10122
NC2=NC2+1	VPL10123
C	VPL10124
C COPY VORTICES AT JSECTN	VPL10125
C	VPL10126
DO 230 J=1,NVN	VPL10127
NC2=NC2+1	VPL10128
JCV=NIP1+1+J	VPL10129
Y2(1,NC2)=Y(JSECTN,JCV)	VPL10130
Y2(1,NC2)=Z(JSECTN,JCV)	VPL10131
NP2(NC2)=1	VPL10132
230 CONTINUE	VPL10133
C	VPL10134
C PLOT CROSS SECTIONS	VPL10135
C	VPL10136
CALL PLOTAP(X2,Y2,3,NP2,17,NC2,LWID,LENG)	VPL10137
WRITE(6,23) JSECTN,Y(1,JSECTN+1)	VPL10138
WRITE(6,24) (I,SYMBOL(I+2),I=1,NVN)	VPL10139
240 CONTINUE	VPL10140
C	VPL10141
C PLOT PERSPECTIVE VIEWS -----	VPL10142
LENG = 50	VPL10143
TOPT = 3	VPL10144
C	VPL10145
C SIDE VIEW	VPL10146
CALL PLOTAP(X,Z,3,NP,NOP,NC,LWID,LENG)	VPL10147
CALL PLOTV2(X,Z,3,NP,NOP,NC,LWID,LENG,LINE,MLTN)	VPL10148
WRITE(6,21)	VPL10149
NSYM=NVN	VPL10150
JSYM=1+NIP1	VPL10151
JN = JSYM+NVN	VPL10152
IF (JN.GT.40) NSYM=JN-40	VPL10153
WRITE(6,24) (I,SYMBOL(I+JSYM),I=1,NSYM)	VPL10154
IF (JN.LE.40) GO TO 210	VPL10155
JSYM=NSYM+1	VPL10156
ISYM = NSYM	VPL10157
WRITE(6,24) (I,SYMBOL(I+ISYM),I=JSYM,NVN)	VPL10158
210 CONTINUE	VPL10159
TOPT = 1	VPL10160
C	VPL10161
C TOP VIEW	VPL10162
CALL PLOTAP(X,Y,3,NP,NOP,NC,LWID,LENG)	VPL10163
CALL PLOTV2(X,Y,3,NP,NOP,NC,LWID,LENG,LINE,MLTN)	VPL10164
WRITE(6,20)	VPL10165
C	VPL10166
C PERSPECTIVE VIEW	VPL10167
TOPT = 3	VPL10168
ROT(1)=0.	VPL10169
ROT(2)=30.	VPL10170
ROT(3)=20.	VPL10171

	CALL PLOTAS(X,Y,Z,ND,NDP,NC,ROT,XCG,X,Y,3)	VPL10172
	CALL PLOTAS2(X,Y,3,ND,NDP,NC,L=10,LENG)	VPL10173
C	CALL PLOTVP(X,Y,3,ND,NDP,NC,L=10,LENG,LINE,CLIN)	VPL10174
	WRITE(6,22) ROT	VPL10175
C		VPL10176
C		VPL10177
20	FORMAT(/20X,22HTOP VIEW = Y VERSUS X)	VPL10178
21	FORMAT(/20X,22HSIDE VIEW = Z VERSUS X)	VPL10179
22	FORMAT(/20X,18PERSPECTIVE = ROT=,3F10.2)	VPL10180
23	FORMAT(/20X,29BODY CROSS SECTION = JSECTN=,I3, * 5X,4HYIP=,F10.3)	VPL10181
24	FORMAT(20X,14VERTEX SYMBOL:,10(1X,I2,1H=,A1,1H,))	VPL10182
C		VPL10183
C		VPL10184
C		VPL10185
	RETURN	VPL10186
	END	VPL10187

	SUBROUTINE SHAPE(X,R,R,S,RP)	VPL11 1
C		VPL11 2
C	THIS SUBROUTINE COMPUTES HORIZONTAL SEMI-MAJOR AXIS AND VERTICAL	VPL11 3
C	SEMI-MAJOR AXIS AND WING SPAN MEASURED FROM THE BODY CENTERLINE.	VPL11 4
C		VPL11 5
C		VPL11 6
C	IF ELLIPTICAL CROSS SECTION, H IS VERTICAL SEMI-AXIS	VPL11 7
C	R IS HORIZONTAL SEMI-AXIS.	VPL11 8
C		VPL11 9
	COMMON/VEL/AL,RE, VX(30),VY(30),G(30),VV, NS,NF,	VPL11 10
	IXF(7),XF(7),YF(7),C(7,7),IFIN	VPL11 11
	COMMON/CONB/HFACT	VPL11 12
	COMMON/CONQ/IGROW	VPL11 13
	IGROW=0	VPL11 14
	IFIN=0	VPL11 15
	DO 1 K=1,NS	VPL11 16
	XL=XF(K)	VPL11 17
	J=K	VPL11 18
	IF(X,LE,XL)GO TO 2	VPL11 19
	1 CONTINUE	VPL11 20
	2 R=C(J,1)+X*C(J,5)+X*X*C(J,6)	VPL11 21
	ARG=X+Y*C(J,2)+Y*C(J,3)+C(J,4)	VPL11 22
	R=R+SQRT(ARG)*C(J,7)	VPL11 23
	IF((C(J,5).GT.0.0).OR.(C(J,6).GT.0.0)) IGROW=1	VPL11 24
	RP=C(J,5)+2.0*C(J,6)*X	VPL11 25
	IF(ARG.LE.0.0) GO TO 5	VPL11 26
	RP=RP+0.5*C(J,7)*(2.0*C(J,2)+X+C(J,3))/SQRT(ARG)	VPL11 27
	IGROW=1	VPL11 28
	5 CONTINUE	VPL11 29
	S=RP	VPL11 30
	H=H+HFACT	VPL11 31
	IF(NF.EQ.0)RETURN	VPL11 32
	IF(X,LE,XF(1),OR,X.GT,XF(NF))RETURN	VPL11 33
	IFIN=1	VPL11 34
	DO 3 K=2,NF	VPL11 35
	J=K	VPL11 36
	XL=XF(K)	VPL11 37
	IF(X,LE,XL)GO TO 4	VPL11 38
	3 CONTINUE	VPL11 39
	4 J1=J-1	VPL11 40
	S=(X-XF(J1))*(YF(J)-YF(J1))/(YF(J)-YF(J1)+YF(J1))	VPL11 41
	RETURN	VPL11 42
	END	VPL11 43

C	SUBROUTINE VOTEX(NV,XV,YV,GV,VV,WV)	VPL12 1
C		VPL12 2
C	THIS SUBROUTINE COMPUTES THE PERTURBATION VELOCITY COMPONENTS AT THE	VPL12 3
C	VERTEX LOCATIONS ACCOUNTING FOR MUTUAL EFFECTS AND THE PRESENCE	VPL12 4
C	OF A WINGED ELLIPTICAL CROSS SECTION	VPL12 5
C		VPL12 6
	DIMENSION XV(30),YV(30),GV(30),VV(30),WV(30)	VPL12 7
	DIMENSION VX(30),VY(30),G(30)	VPL12 8
	COMMON/VV/AA,RA	VPL12 9
	COMMON/RLK1/A,R,S,PI,CI	VPL12 10
	COMMON/CON7/B	VPL12 11
	COMMON/CON1/AA,RR,RR	VPL12 12
	COMMON/CON2/SIG2,H2	VPL12 13
	COMPLEX CI,IG,Z,SD,DSOT,OTOS,D2SOT,V1,V2,V3,VEL,TAU,S1,SHR,SH	VPL12 14
	2,DSDZ,D7DS,D2SDZ2	VPL12 15
	EXTERNAL Z,DSDZ,D7DS,D2SDZ2	VPL12 16
	NN=NV-1	VPL12 17
	AA=AA+4	VPL12 18
	RR=RR+8	VPL12 19
	APR=AA+R	VPL12 20
	APH2=APH+APH	VPL12 21
	R1=S+SDOT(S+S=AA+RR)	VPL12 22
	H=0.25*(R1+APH2/R1)	VPL12 23
	H=H+R	VPL12 24
	H2=H+H	VPL12 25
	SIG=0.5*APH	VPL12 26
	SIG2=SIG*SIG	VPL12 27
	RR=RR+H	VPL12 28
	DO 100 I=1,NV	VPL12 29
	X0=XV(I)	VPL12 30
	Y0=YV(I)	VPL12 31
	G0=GV(I)	VPL12 32
	K1=0	VPL12 33
	DO 99 J=1,NV	VPL12 34
	IF(J.EQ,I)GO TO 99	VPL12 35
	K1=K1+1	VPL12 36
	VX(K1)=XV(J)	VPL12 37
	VY(K1)=YV(J)	VPL12 38
	G(K1)=GV(J)	VPL12 39
	99 CONTINUE	VPL12 40
	T=CMLX(X0,Y0)	VPL12 41
	SH=Z(T0)	VPL12 42
	SH=CMLJG(S0)	VPL12 43
	DSOT=DSDZ(S0)	VPL12 44
	OTOS=D7DS(S0)	VPL12 45
	D2SDT=D2SDZ2(S0)	VPL12 46
	V1=G0*OTOS+D2SDT/2.	VPL12 47
	V2=G0*DSOT+SH/(S0+SD+RR)	VPL12 48
	V3=CMLX(1.,0.)	VPL12 49
	DO 3 K=1,NV	VPL12 50
	TAU=CMLX(VX(K),VY(K))	VPL12 51
	S1=Z(TAU)	VPL12 52
	S1B=CMLJG(S1)	VPL12 53
	V3=V3-G(K1)*(1./(S0-S1)-S1H/(S0+S1H+RR))+DSOT	VPL12 54
	VEL=CT*(V1+V2+V3)/(R1+PI)	VPL12 55
	VV(I)=OPAL(VEL)	VPL12 56
	WV(I)=-1/2*AG(VEL)	VPL12 57
100	CONTINUE	VPL12 58
	RETURN	VPL12 59
	END	VPL12 60

	SUBROUTINE VVELS(NV,YY,ZZ,VY,VV,GAH,HH,S,V,W,VRTMAX)	VPL13 1
C		VPL13 2
C	THIS SUBROUTINE COMPUTES PERTURBATION VELOCITY COMPONENTS DUE TO	VPL13 3
C	NV EXTERNAL VORTICES AND THEIR IMAGES INSIDE A BODY WITH	VPL13 4
C	ELLIPTICAL CROSS SECTION WITH OR WITHOUT MONO-PLANE WING.	VPL13 5
C		VPL13 6
C		VPL13 7
C	DIMENSION VX(1),VY(1),G(1)	VPL13 8
C		VPL13 9
C	COMMON/COM1/A2,H2,H2	VPL13 10
C	COMMON/COM2/SIG2,H2	VPL13 11
C	COMMON/PARAM/NOOT	VPL13 12
C		VPL13 13
C	COMPLEX T0,V1,OSDT,Z,OSDZ,S1,S1H,S0,TAU,C1,VEL	VPL13 14
C		VPL13 15
C	EXTERNAL Z,OSDZ	VPL13 16
C		VPL13 17
700	FORMAT (5X,15,5X,F10.5,1X,F10.5, 4(2X,F10.5,1X,F10.5))	VPL13 18
701	FORMAT (/5X,4HIVRT,14X,2H\$1,21X,3H\$1H,21X,2HV1,21X,4HOSDT,21X,	VPL13 19
	1 2H\$0/	VPL13 20
	1 14X,2HRE,9X,2HIM,10X,2HRE,9X,2HIM,11X,2HRE,9X,2HIM,11X,2HRE,	VPL13 21
	1 9X,2HIM,11X,2HRE,9X,2HIM)	VPL13 22
C		VPL13 23
	PI=3.14159265	VPL13 24
	TLC=0.001	VPL13 25
	C1=CMPLX(0.0,1.0)	VPL13 26
	A2=AH*AH	VPL13 27
	H2=RH*RH	VPL13 28
	APR=AH*RH	VPL13 29
	APH2=APH*APH	VPL13 30
	S1=S+SQRT(S+S=A2+H2)	VPL13 31
	R=0.25*(R1+APR2/R1)	VPL13 32
	R2=RH	VPL13 33
	H=H+R	VPL13 34
	H2=H*H	VPL13 35
	SIG=0.5*APH	VPL13 36
	SIG2=SIG*SIG	VPL13 37
	T0=CMPLX(VY,ZZ)	VPL13 38
	S0=Z(T0)	VPL13 39
	V1=CMPLX(0.0,0.0)	VPL13 40
	OSDT=OSDZ(S0)	VPL13 41
C		VPL13 42
C	DOOR OVER THE NUMBER OF VORTICES,NV	VPL13 43
C		VPL13 44
	IF (NOOT.GE.2) WRITE (6,701)	VPL13 45
	NO=1 I=1,NV	VPL13 46
	TAU=CMPLX(VX(I),VY(I))	VPL13 47
	S1=Z(TAU)	VPL13 48
	S1H=CONJG(S1)	VPL13 49
	OSCAR=ST-S0	VPL13 50
	IF(0.LE.TLC) GO TO 2	VPL13 51
	V1=V1+G(I)/(S0-S1)	VPL13 52
2	CONTINUE	VPL13 53
	OSCAR=OSCAR+R2/S1H	VPL13 54
	IF(0.LE.TLC) GO TO 1	VPL13 55
	V1=V1+G(I)/(S0+H2/S1H)	VPL13 56
	IF (NOOT.GE.2) WRITE (6,700) I,S1,S1H,V1,OSDT,S0	VPL13 57
1	CONTINUE	VPL13 58
C		VPL13 59
	VEL=0.5*C1*V1*OSDT/PI	VPL13 60
	VX=REAL(VEL)	VPL13 61
	VY=AIMAG(VEL)	VPL13 62
	AV=ABS(V)	VPL13 63

ANBAR(N)	VPL13 64
IF(V.GT.0.0.AND.AV.GE.VRTMAX) V=VRTMAX	VPL13 65
IF(V.LT.0.0.AND.AV.GE.VRTMAX) V=-VRTMAX	VPL13 66
IF(A.GT.0.0.AND.AW.GE.VRTMAX) A=VRTMAX	VPL13 67
IF(A.LT.0.0.AND.AW.GE.VRTMAX) A=-VRTMAX	VPL13 68
RETURN	VPL13 69
END	VPL13 70
COMPLEX FUNCTION Z(CT)	VPL14 1
C THIS FUNCTION SUBROUTINE CALCULATES THE ZETA VALUE IN THE	VPL14 2
C TRANSFORMED (CIRCLE) PLANE FOR GIVEN TAU IN THE PHYSICAL PLANE	VPL14 3
C FOR AN ELLIPTICAL BODY WITH WINGS	VPL14 4
C	VPL14 5
COMMON/COM2/SIG2,M2	VPL14 6
COMMON/COM3/ZR,ZI	VPL14 7
COMMON/COM4/G2,G1	VPL14 8
COMMON/COM5/M2,M	VPL14 9
COMMON/PAPAM/NOU	VPL14 10
C	VPL14 11
COMPLEX G1,G2;CT,M2,DBLU	VPL14 12
C	VPL14 13
700 FORMAT (/19X,2FG1,22X,2HG2/14X,2HRE,9X,2HIV,11X,2HRE,9X,2HIM)	VPL14 14
701 FORMAT (10X,F10.5,1X,F10.5,2X,F10.5,1X,F10.5)	VPL14 15
C	VPL14 16
EXTERNAL DBLU	VPL14 17
C	VPL14 18
WRITE(CT)	VPL14 19
G1=SIG2/M2	VPL14 20
G2=G1+G1-M2	VPL14 21
IF(NOUT.EQ.2) WRITE (6,700)	VPL14 22
IF(NOUT.EQ.2) WRITE (6,701) G1,G2	VPL14 23
Y=ATNAG(G2)	VPL14 24
AY=1.0	VPL14 25
IF(Y.LT.0.0) AY=-1.0	VPL14 26
YZ=AY*AG(G1)	VPL14 27
AYZ=1.0	VPL14 28
IF(YZ.LT.0.0) AYZ=-1.0	VPL14 29
G2=CSQRT(G2)*AY*AYZ	VPL14 30
IF(NOUT.EQ.2) WRITE (6,701) G1,G2	VPL14 31
IF((ABS(YZ).LE.0.0).AND.(REAL(G1).LT.0.0)) G2=CMPLX(-REAL(G2),	VPL14 32
1.0*ATNAG(G2))	VPL14 33
IF(NOUT.EQ.2) WRITE (6,701) G1,G2	VPL14 34
Z=0.5*(G1+G2)	VPL14 35
IF((ABS(ZI).NE.0.0).AND.(ABS(ZR).NE.0.0)) Z=CMPLX(ZR*ABS(REAL(Z)),	VPL14 36
ZI*ABS(ATNAG(Z)))	VPL14 37
RETURN	VPL14 38
END	VPL14 39
	VPL14 40



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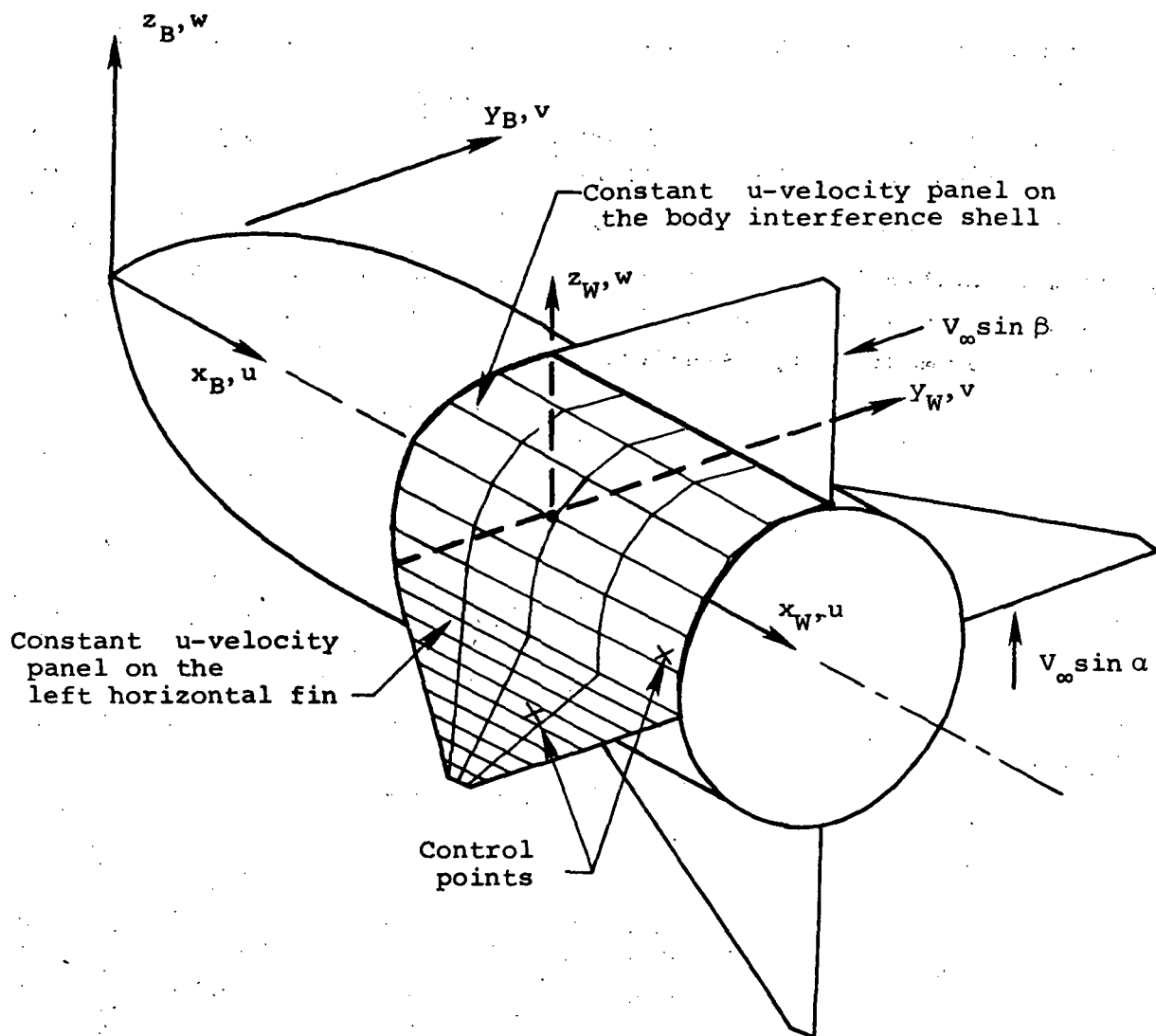


Figure 1.- Coordinate systems and typical panel layout shown for one fin and quarter of the interference shell.

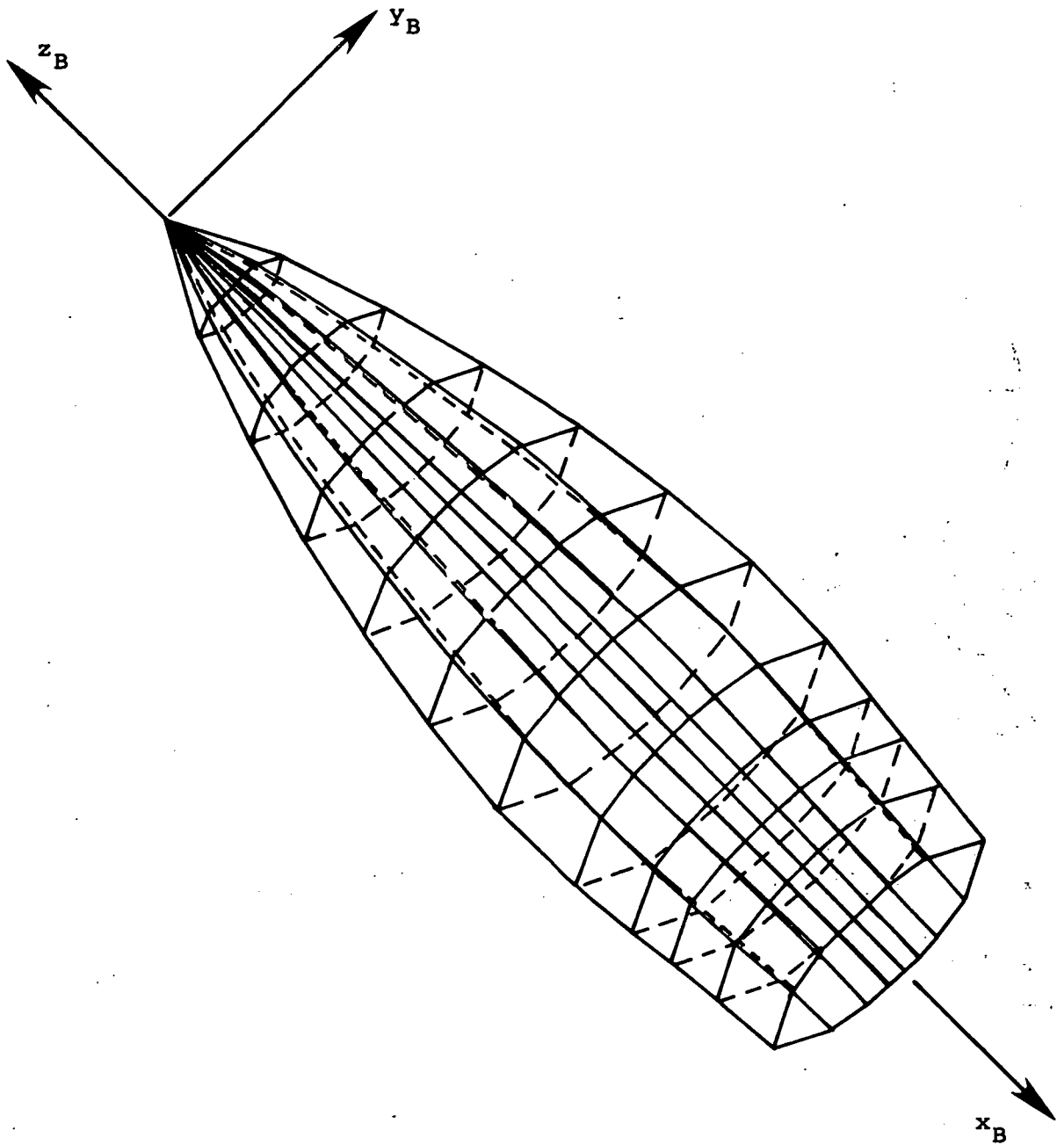
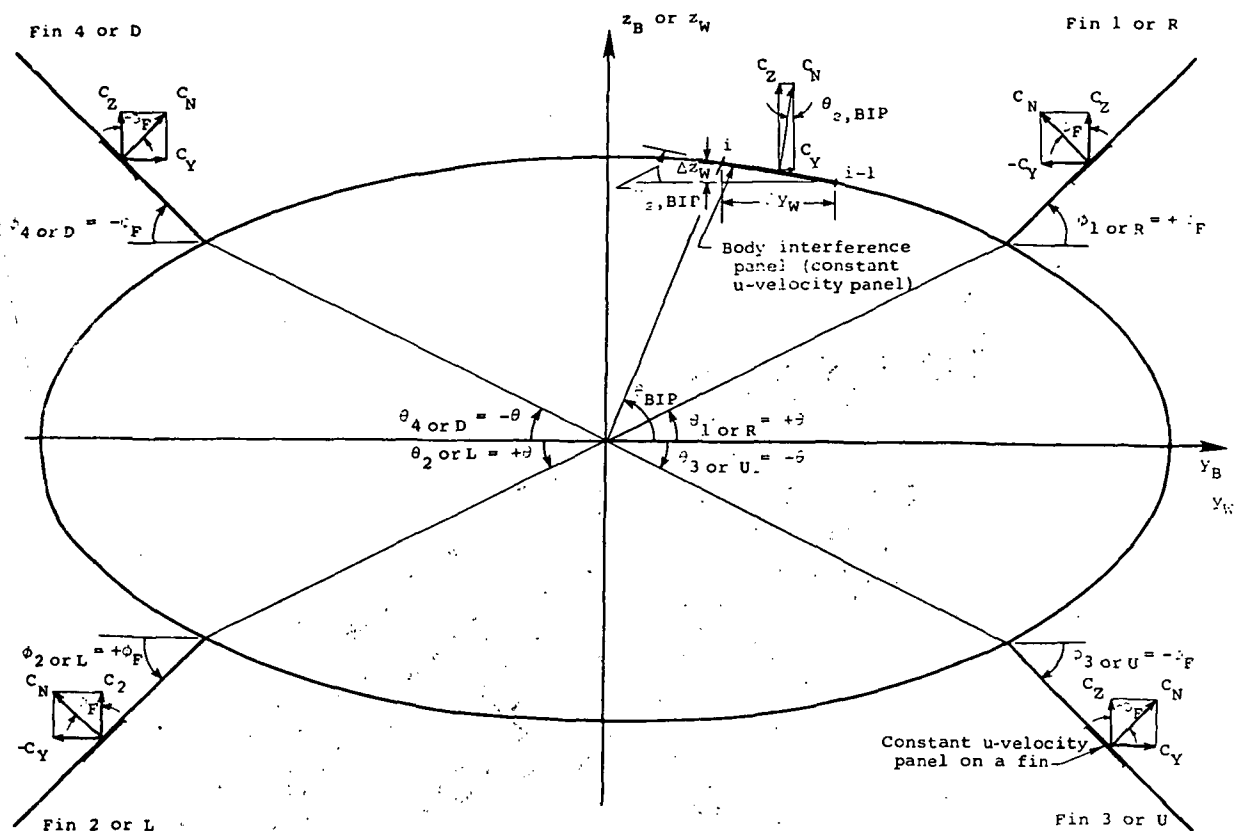


Figure 2.- Isometric view of typical layout of body source panels on the surface of a body with elliptical cross section, 11 rings with 16 panels each.



- $\phi_F$  = fin dihedral angle, PHIDIH  
 $\phi_1$  or R = dihedral angle of right upper fin, PHIFR=PHIDIH  
 $\phi_2$  or L = dihedral angle of left lower fin, PHIFL=PHIDIH  
 $\phi_3$  or U = dihedral angle of right lower fin, PHIFU=-PHIDIH  
 $\phi_4$  or D = dihedral angle of left upper fin, PHIFD=-PHIDIH  
 $\theta$  = fin location polar angle, THETIT  
 $\theta_1$  or R = polar angle of right upper fin, THETR=THETIT  
 $\theta_2$  or L = polar angle of left lower fin, THETL=THETIT  
 $\theta_3$  or U = polar angle of right lower fin, THETI=-THETIT  
 $\theta_4$  or D = polar angle of left upper fin, THETD=-THETIT

Body interference panels:

$$\theta_{BIP,j} = \text{THETI}(j),$$

$$\Delta z_W = z_{W,i} - z_{W,i-1}$$

$$\Delta y_W = y_{W,i} - y_{W,i-1}$$

$$\sin \theta_{2,BIP} = \frac{\Delta z_W}{\sqrt{\Delta z_W^2 + \Delta y_W^2}}$$

$$\cos \theta_{2,BIP} = \frac{-\Delta y_W}{\sqrt{\Delta z_W^2 + \Delta y_W^2}}$$

these functions are used in the transformation (rotation) of the body interference panel to the reference  $(x_B, y_B, z_B)$  or  $(x_W, y_W, z_W)$  system

Figure 3.- Geometrical angles associated with case involving interdigitated tails on body with elliptical cross section as required by program DEMON2. Force coefficients associated with fins and body interference panel.

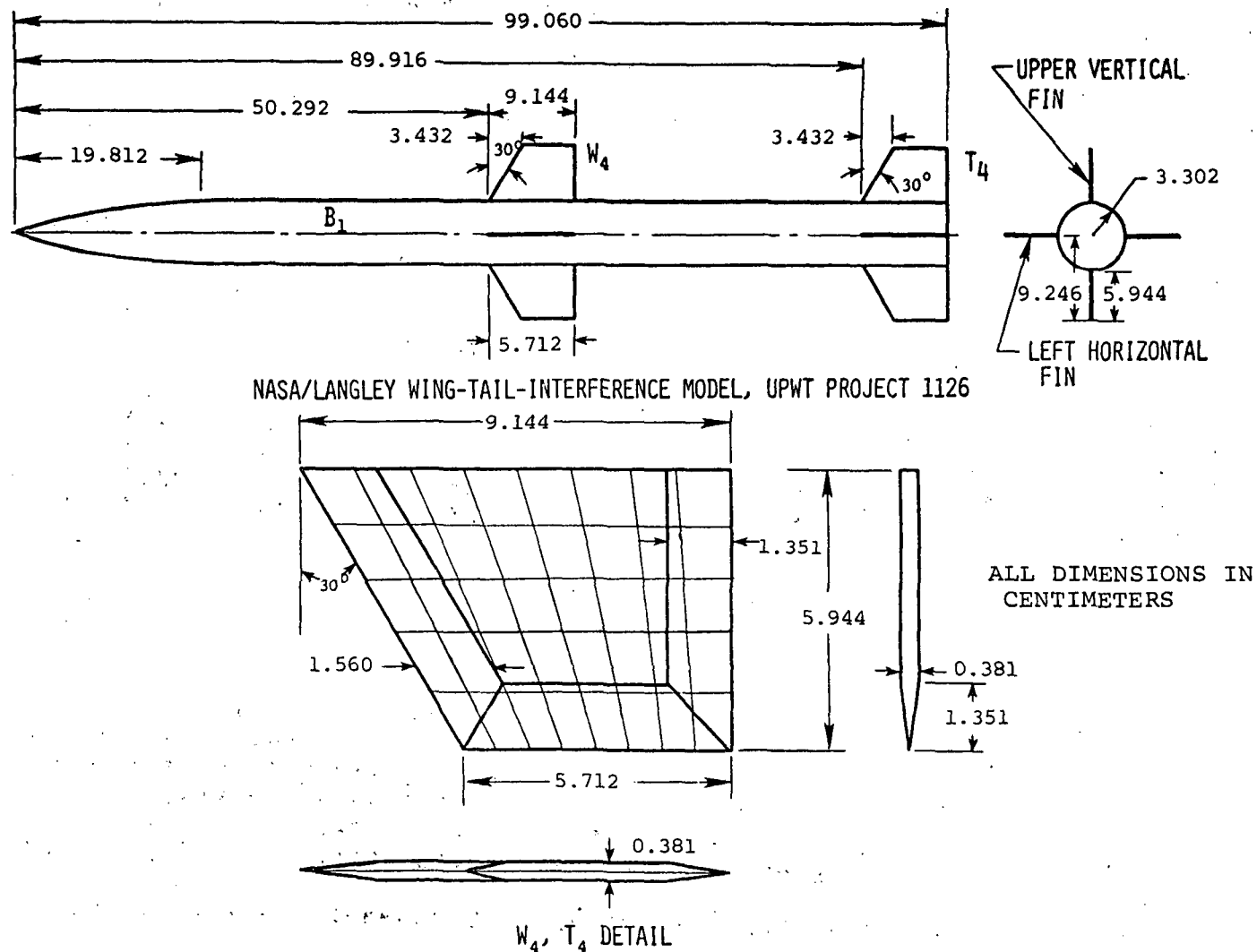


Figure 4.- Configuration used for first calculation example.

NASA/LANGLEY WING-TAIL INTERFERENCE MODEL, INPUT PROJ. 1126, CONFIGURATION B1W4.  
 \$INPUT  
 CRP=3.6, SWLEP=30.0, H2=2.34, SWLEV=30.0, CRPV=3.6, H2V=2.34,  
 NCW=3, MSWR=5, MSWL=5, MSWD=5, MSWD=5, NCRX=1,  
 ALFAC=14.216, PHI=45.0, FMACH=1.7,  
 RB=1.3, NHDQR=16, NCAB=3, BIL=3.6, XWLF=19.8,  
 SREF=5.50929, REFL=2.69,  
 NOLINP=1, NOUT=0, NDRAG=1, NRDYPR=1,  
 VRTMAX=0.5,  
 NCPOUT=1,  
 NTDAT=1, NCWT=8,  
 XM=19.5, ZM=0.0,  
 \$END  

5	0	0						
0.122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.141
0.122	0.122	0.0	0.0	0.0	0.0	0.0	0.0	-0.141
0.122	0.122	0.0	0.0	0.0	0.0	0.0	0.0	-0.141
0.122	0.122	0.0	0.0	0.0	0.0	0.0	-0.141	-0.141
0.122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.141

 \$BODY  
 NXBODY=39, LNOSE=7.8, LHODY=39.0, BCORE=2,  
 \$END

7777777777

Figure 5.- Input for program DEMON2, first sample case, step 16.



NASA/LANGLEY WING-TAIL INTERFERENCE MODEL, HPWT PROJ. 1126, CONFIGURATION B1=0.  
 SENDIT

CRP	= .36E+01,	SREF	= .530929E+01,
S+LEP	= .3E+02,	REFL	= .269E+01,
S+TEP	= 0.0,	PHINTH	= 0.0,
NCN	= 3,	THETIT	= 0.0,
MS+R	= 5,	X4LE	= .198E+02,
MS+L	= 5,	NOLINP	= 1,
ALFAC	= .14216E+02,	NOUT	= 0,
PMI	= .45E+02,	NPR	= 0,
B2	= .234E+01,	NDRAG	= 1,
FMACH	= .17E+01,	NVRTX	= 0,
LVS+P	= 0,	NPRESS	= 0,
FAC	= .95E+00,	VRTXAX	= .5E+00,
MFVAPR	= 0,	NCWR	= 3,
TOLFAC	= .1E+01,	VAGAIN	= 0,
MS+U	= 5,	RIL	= .36E+01,
MS+D	= 5,	ITATI	= 0,
S+LEV	= .3E+02,	NVRTPL	= 0,
S+TFV	= 0.0,	NHDYPR	= 1,
CRPV	= .36E+01,	NTPR	= 0,
B2V	= .234E+01,	NTDAT	= 1,
NCRX	= 1,	NCWT	= 0,
RR	= .13E+01,	NCPDIT	= 1,
RA	= .13E+01,	NVELTH	= 0,
COATIO	= .1E+01,	XSTART	= 0.0,
NHDCR	= 16,	JCPT	= 0,
DELR	= 0.0,	FKLE	= .5E+00,
DELL	= 0.0,	FKSE	= .5E+00,
DELR	= 0.0,	X4	= .195E+02,
DELD	= 0.0,	Z4	= 0.0,
		SEND	

Figure 6.- Output of program DEMON2, first sample case, step 1b.

# WING GEOMETRY

TIP CHORD = 2.24900  
 ROOT CHORD = 5.60000  
 WING SEMISPAN = 2.34000

LEADING EDGE SKEW = 30.00000 DEGREES  
 TRAILING EDGE SKEW = 0.00000 DEGREES

## FLIGHT CONDITIONS

MACH = 1.70000 ALPHAC = 14.21600 PHI = 45.00000 ALFA = 10.00000 BETA = 10.00010

CRPT = 3.60000  
 CRPTV = 3.60000

## WING THICKNESS INPUT DATA

SPANWISE LOCATIONS OF PANEL SIDE EDGES AND SKEW ANGLES  
 OF WING SECTION TO THE LEFT

I	SPANWISE LOCATION FEET	LE SKEW DEGREES	TE SKEW DEGREES
---	------------------------------	--------------------	--------------------

## RIGHT WING SURFACE

1	1.30000	0.00000	0.00000
2	1.76000	30.00000	0.00000
3	2.23600	30.00000	0.00000
4	2.70000	30.00000	0.00000
5	3.17200	30.00000	0.00000
6	3.64000	30.00000	0.00000

40 THICKNESS PANELS ARE TO BE Laid OUT  
 5 CHORDWISE ROWS WITH 8 IN EACH ROW

## UPPER WING SURFACE

1	1.30000	0.00000	0.00000
2	1.76000	30.00000	0.00000
3	2.23600	30.00000	0.00000
4	2.70000	30.00000	0.00000
5	3.17200	30.00000	0.00000
6	3.64000	30.00000	0.00000

40 THICKNESS PANELS ARE TO BE Laid OUT  
 5 CHORDWISE ROWS WITH 8 IN EACH ROW

Figure 6.- Continued.

INPUT VALUES OF THE LOCAL SURFACE SLOPE OF THE THICKNESS  
DISTRIBUTION, FOR EACH CROSSWISE ROW THE FIRST VALUE  
IS FOR THE PANEL NEAREST THE LEADING EDGE

## RIGHT WING SURFACE

ROW	SLOPES							
1	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
2	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
3	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
4	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
5	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100

## UPPER WING SURFACE

ROW	SLOPES							
1	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
2	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
3	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
4	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
5	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100

## CONTROL POINTS WRITTEN ON TAPE4

I	XCPT	YCPT	ZCPT
1	1.2311	1.5310	0.
2	2.4867	1.5310	0.
3	3.5422	1.5310	0.
4	1.4157	1.9987	0.
5	2.4812	1.9987	0.
6	3.5467	1.9987	0.
7	1.6002	2.4664	0.
8	2.5757	2.4664	0.
9	3.5512	2.4664	0.
10	1.7847	2.9340	0.
11	2.6702	2.9340	0.
12	3.5557	2.9340	0.
13	1.9691	3.4016	0.
14	2.7647	3.4016	0.
15	3.5602	3.4016	0.
16	1.2311	-1.5310	0.
17	2.4867	-1.5310	0.
18	3.5422	-1.5310	0.
19	1.4157	-1.9987	0.
20	2.4812	-1.9987	0.
21	3.5467	-1.9987	0.
22	1.6002	-2.4664	0.
23	2.5757	-2.4664	0.
24	3.5512	-2.4664	0.
25	1.7847	-2.9340	0.
26	2.6702	-2.9340	0.
27	3.5557	-2.9340	0.
28	1.9691	-3.4016	0.
29	2.7647	-3.4016	0.
30	3.5602	-3.4016	0.
31	1.2311	0.	1.5310
32	2.4867	0.	1.5310

Figure 6.- Continued.

33	3.5422	0.	1.5110
34	3.4157	0.	1.9987
35	2.4812	0.	1.9987
36	3.5467	0.	1.9987
37	1.6002	0.	2.4864
38	2.5757	0.	2.4864
39	3.5512	0.	2.4864
40	1.7847	0.	2.9340
41	2.6702	0.	2.9340
42	3.5557	0.	2.9340
43	1.9691	0.	3.4016
44	2.7647	0.	3.4016
45	3.5602	0.	3.4016
46	1.2311	0.	-1.5310
47	2.3467	0.	-1.5310
48	3.5422	0.	-1.5310
49	1.4157	0.	-1.9987
50	2.4812	0.	-1.9987
51	3.5467	0.	-1.9987
52	1.6002	0.	-2.4864
53	2.5757	0.	-2.4864
54	3.5512	0.	-2.4864
55	1.7847	0.	-2.9340
56	2.6702	0.	-2.9340
57	3.5557	0.	-2.9340
58	1.9691	0.	-3.4016
59	2.7647	0.	-3.4016
60	3.5602	0.	-3.4016
61	1.1400	1.2505	.24874
62	1.1400	1.0601	.70836
63	1.1400	.70836	1.0601
64	1.1400	.24874	1.2505
65	1.1400	-.24874	1.2505
66	1.1400	-.70836	1.0601
67	1.1400	-1.0601	.70836
68	1.1400	-1.2505	.24874
69	1.1400	-1.2505	-.24874
70	1.1400	-1.0601	-.70836
71	1.1400	-.70836	-1.0601
72	1.1400	-.24874	-1.2505
73	1.1400	.24874	-1.2505
74	1.1400	.70836	-1.0601
75	1.1400	1.0601	-.70836
76	1.1400	1.2505	-.24874
77	2.3400	1.2505	.24874
78	2.3400	1.0601	.70836
79	2.3400	.70836	1.0601
80	2.3400	.24874	1.2505
81	2.3400	-.24874	1.2505
82	2.3400	-.70836	1.0601
83	2.3400	-1.0601	.70836
84	2.3400	-1.2505	.24874
85	2.3400	-1.2505	-.24874
86	2.3400	-1.0601	-.70836
87	2.3400	-.70836	-1.0601
88	2.3400	-.24874	-1.2505
89	2.3400	.24874	-1.2505
90	2.3400	.70836	-1.0601

91	2.3400	1.0601	-.70836
92	2.3400	1.2505	-.24874
93	3.5400	1.2505	.24874
94	3.5400	1.0601	.70836
95	3.5400	.70836	1.0601
96	3.5400	.24874	1.2505
97	3.5400	-.24874	1.2505
98	3.5400	-.70836	1.0601
99	3.5400	-1.0601	.70836
100	3.5400	-1.2505	.24874
101	3.5400	-1.2505	-.24874
102	3.5400	-1.0601	-.70836
103	3.5400	-.70836	-1.0601
104	3.5400	-.24874	-1.2505
105	3.5400	.24874	-1.2505
106	3.5400	.70836	-1.0601
107	3.5400	1.0601	-.70836
108	3.5400	1.2505	-.24874

BRNDV

NRNDV = 39.

LNDSF = .7AF+01.

LRNDV = .39F+02.

BCODE = 2.

SEND

Figure 6.- Continued.

PHYSICAL DIMENSIONS OF BODY AND LINE SINGULARITY STRENGTHS REPRESENTING THE BODY AT  $\rho_{\text{ACH}} = 1.7000$ 

ALFACB 10.2160

X	U	DM/DX	TX	T(1)	T(1)
1 0.0000	-.02633E-13	.34284	-.58610E-13	.10092	.34463E-01
2 1.0263	.32639	.29453	.57741	-.00121E-01	-.10955E-01
3 2.0526	.00316	.24611	1.2244	-.25012E-01	-.02844E-02
4 3.0789	.05207	.20020	1.9350	-.23274E-01	-.01341E-02
5 4.1053	1.0165	.15547	2.7106	-.18861E-01	-.74517E-02
6 5.1316	1.1515	.11164	3.5085	-.15477E-01	-.75494E-02
7 6.1579	1.2439	.08039E-01	4.0479	-.11952E-01	-.73645E-02
8 7.1842	1.2921	.25613E-01	5.0078	-.083169E-02	-.70718E-02
9 8.2105	1.3000	0.	6.4243	.31078E-01	-.24112E-02
10 9.2368	1.3000	0.	7.4444	.35293E-02	.47755E-02
11 10.2632	1.3000	0.	8.4740	.34044E-02	.39930E-02
12 11.2895	1.3000	0.	9.5023	.14132E-02	.36673E-02
13 12.3158	1.3000	0.	10.529	.93069E-03	.28432E-02
14 13.3421	1.3000	0.	11.555	.55466E-03	.17806E-02
15 14.3684	1.3000	0.	12.581	.36257E-03	.10708E-02
16 15.3947	1.3000	0.	13.608	.23850E-03	.56355E-03
17 16.4211	1.3000	0.	14.634	.16227E-03	.22980E-03
18 17.4474	1.3000	0.	15.660	.11249E-03	.33410E-04
19 18.4737	1.3000	0.	16.686	.79559E-04	-.67255E-04
20 19.5000	1.3000	0.	17.713	.57218E-04	-.10624E-03
21 20.5263	1.3000	0.	18.739	.41794E-04	-.10943E-03
22 21.5526	1.3000	0.	19.765	.30961E-04	-.05708E-04
23 22.5789	1.3000	0.	20.792	.23276E-04	-.75192E-04
24 23.6053	1.3000	0.	21.818	.17650E-04	-.54633E-04
25 24.6316	1.3000	0.	22.844	.13556E-04	-.37078E-04
26 25.6579	1.3000	0.	23.871	.10525E-04	-.25532E-04
27 26.6842	1.3000	0.	24.897	.82509E-05	-.15875E-04
28 27.7105	1.3000	0.	25.923	.65280E-05	-.74713E-05
29 28.7368	1.3000	0.	26.950	.52100E-05	-.35327E-05
30 29.7632	1.3000	0.	27.976	.41922E-05	-.13202E-05
31 30.7895	1.3000	0.	29.002	.33993E-05	-.22844E-06
32 31.8158	1.3000	0.	30.029	.27766E-05	.19378E-06
33 32.8421	1.3000	0.	31.055	.22435E-05	.25675E-06
34 33.8684	1.3000	0.	32.081	.18903E-05	.15744E-06
35 34.8947	1.3000	0.	33.108	.15745E-05	.11691E-07
36 35.9211	1.3000	0.	34.134	.13191E-05	-.12295E-06
37 36.9474	1.3000	0.	35.160	.11112E-05	-.22221E-06
38 37.9737	1.3000	0.	36.186	.94102E-06	-.28186E-06
39 39.0000	1.3000	0.	37.213	0.	0.

## PRESSURE COEFFICIENTS AT POINTS ON BODY MERIDIANS

1	THETA, DEG.	ZH	YH	ZH	UTOT	VTOT	WTOT	CP,LIN.	CP,REFN.	DR/DX	P/DIN, REFN.	P/DIN, LIN.
---	----------------	----	----	----	------	------	------	---------	----------	-------	-----------------	----------------

TOTAL NUMBER OF PRESSURE POINTS: 320

BODY RINGS 1

1	11.25000	.51316	.16626	.03307	-.20308	.36619	.14431	.40615	.31470	.31793	1.63644	1.82164
2	22.50000	.51316	.15662	.04487	-.18444	.24906	.22763	.34934	.20360	.31793	1.40299	1.74720

Figure 6.- Continued.

3	51,75000	.51310	.10995	.09418	-.16471	.20227	.26242	.32442	.18128	.31773	1.36673	1.66602
4	45,00000	.51310	.11987	.11987	-.10395	.11616	.26874	.28789	.13035	.31793	1.26371	1.58241
5	56,25000	.51310	.09418	.14005	-.12318	.04000	.25033	.24637	.09186	.31793	1.18533	1.49840
6	67,50000	.51310	.06487	.15062	-.10322	-.01932	.21344	.20644	.06525	.31793	1.13200	1.41742
7	78,75000	.51310	.03307	.16626	-.08482	-.05811	.16788	.16964	.04898	.31793	1.09908	1.34318
8	90,00000	.51310	-.00000	.16952	-.06869	-.07629	.12065	.13738	.04083	.31793	1.08261	1.27792
9	101,25000	.51310	-.03307	.16626	-.05545	-.07713	.08050	.11091	.03828	.31793	1.07744	1.22437
10	112,50000	.51310	-.06487	.15662	-.04562	-.06654	.05225	.09124	.03876	.31793	1.07862	1.18458
11	123,75000	.51310	-.09418	.14005	-.03956	-.05195	.03986	.07913	.04007	.31793	1.08107	1.16007
12	135,00000	.51310	-.11987	.11987	-.03752	-.04093	.04093	.07504	.04089	.31793	1.08232	1.15180
13	146,25000	.51310	-.14095	.09418	-.03956	-.03986	.05195	.07913	.04007	.31793	1.08107	1.16007
14	157,50000	.51310	-.15662	.06487	-.04562	-.05225	.06654	.09124	.04876	.31793	1.07862	1.18458
15	168,75000	.51310	-.16626	.03307	-.05545	-.06654	.07713	.11091	.03828	.31793	1.07744	1.22437
16	180,00000	.51310	-.16952	-.00000	-.06869	-.12065	.07629	.13738	.04083	.31793	1.08261	1.27792
17	191,25000	.51310	-.16626	-.03307	-.08482	-.16788	.05811	.16964	.04898	.31793	1.09908	1.34318
18	202,50000	.51310	-.15662	-.06487	-.10322	-.21344	.01932	.20644	.06525	.31793	1.13200	1.41742
19	213,75000	.51310	-.14095	-.09418	-.12318	-.25033	.04000	.24637	.09186	.31793	1.18533	1.49840
20	225,00000	.51310	-.11987	-.11987	-.14395	-.26874	-.11616	.28789	.13035	.31793	1.26371	1.58241
21	236,25000	.51310	-.09418	-.14005	-.16471	-.26242	-.20227	.32942	.18128	.31793	1.36673	1.66602
22	247,50000	.51310	-.06487	-.15062	-.18488	-.22783	-.28906	.36935	.24369	.31793	1.49299	1.74720
23	258,75000	.51310	-.03307	-.16626	-.20388	-.16431	-.36619	.40615	.31470	.31793	1.63664	1.82164
24	270,00000	.51310	-.00000	-.16952	-.21920	-.07629	-.42368	.43841	.38919	.31793	1.78734	1.88690
25	281,25000	.51310	.03307	-.16626	-.23244	.02907	-.45337	.46488	.46006	.31793	1.93070	1.94005
26	292,50000	.51310	.06487	-.15662	-.24227	.14177	-.45015	.48455	.51904	.31793	2.05002	1.99024
27	303,75000	.51310	.09418	-.14005	-.24813	.25047	-.41274	.49686	.55827	.31793	2.12939	2.00475
28	315,00000	.51310	.11987	-.11987	-.25033	.34397	-.34397	.50075	.57205	.31793	2.15725	2.01302
29	326,25000	.51310	.14095	-.09418	-.24813	.41274	-.25047	.49686	.55827	.31793	2.12939	2.00475
30	337,50000	.51310	.15662	-.06487	-.24227	.45015	-.14177	.48455	.51904	.31793	2.05002	1.99024
31	348,75000	.51310	.16626	-.03307	-.23244	.45337	-.02907	.46488	.46006	.31793	1.93070	1.94005
32	360,00000	.51310	.16952	-.00000	-.21920	.42368	.07629	.43841	.38919	.31793	1.78734	1.88690

RNDY PING 2

1	11,25000	2.56579	.70961	.14115	-.14124	.29958	.18203	.28247	-.19422	.22298	1.30291	1.57144
2	22,50000	2.56579	.66843	.27687	-.12479	.21696	.23429	.24959	.12886	.22298	1.26089	1.50491
3	33,75000	2.56579	.60157	.40196	-.10695	.12713	.25530	.21390	.07368	.22298	1.14905	1.43273
4	45,00000	2.56579	.51160	.51160	-.08940	.04161	.24586	.17679	.03113	.22298	1.06297	1.35766
5	56,25000	2.56579	.40196	.60157	-.06980	-.02944	.21090	.13969	.00171	.22298	1.00347	1.28258
6	67,50000	2.56579	.27687	.66843	-.05200	-.07871	.15864	.10400	-.01550	.22298	.98864	1.21040
7	78,75000	2.56579	.14115	.70961	-.03556	-.10271	.09915	.07112	-.02244	.22298	.95460	1.14377
8	90,00000	2.56579	-.00000	.72351	-.02115	-.10212	.04282	.04224	-.02170	.22298	.95609	1.08556
9	101,25000	2.56579	-.14115	.70961	-.00932	-.08155	-.00133	.01864	-.01644	.22298	.96695	1.03770
10	112,50000	2.56579	-.27687	.66843	-.00053	-.04863	-.02703	.00106	-.00950	.22298	.98077	1.00214
11	123,75000	2.56579	-.40196	.60157	.00088	-.01272	-.03168	-.00977	-.00406	.22298	.99179	.98024
12	135,00000	2.56579	-.51160	.51160	.00871	.01671	-.01362	-.00200	-.00200	.22298	.99595	.97283
13	146,25000	2.56579	-.60157	.40196	.00888	.03168	-.01272	-.00977	-.00406	.22298	.99179	.98024
14	157,50000	2.56579	-.66843	.27687	.00053	.02703	.04863	.00106	-.00950	.22298	.98077	1.00214
15	168,75000	2.56579	-.70961	.14115	.00032	.00133	.08155	.01864	-.01644	.22298	.96695	1.03770
16	180,00000	2.56579	-.72351	-.00000	-.02115	.04282	.10212	.04224	-.02170	.22298	.95609	1.08556
17	191,25000	2.56579	-.70961	.14115	-.03556	-.09915	.07112	-.02244	-.02244	.22298	.95460	1.14377
18	202,50000	2.56579	-.66843	.27687	-.05200	-.15864	.07871	.10400	-.01550	.22298	.98864	1.21040
19	213,75000	2.56579	-.60157	.40196	-.06980	-.21090	.02944	.13969	.00171	.22298	1.00347	1.28258
20	225,00000	2.56579	-.51160	.51160	-.08940	-.24586	-.04161	.17679	.03113	.22298	1.06297	1.35766
21	236,25000	2.56579	-.40196	.60157	-.10695	-.25530	-.12713	.21390	.07368	.22298	1.14905	1.43273
22	247,50000	2.56579	-.27687	.66843	-.12479	-.26242	-.20227	.32942	.18128	.22298	1.26371	1.58241
23	258,75000	2.56579	-.14115	.70961	-.14124	-.29958	-.18203	.28247	-.19422	.22298	1.30291	1.57144

Figure 6.- Continued.

24	274,00000	2,56579	.00000	-.72351	-.15565	-.10212	-.36372	.31130	.26490	.22298	1,53589	1,62975
25	281,25000	2,56579	.14115	-.70941	-.14708	-.00223	-.48006	.33495	.33372	.22298	1,67511	1,67761
26	292,50000	2,56579	.27687	-.66843	-.17427	.14695	-.40243	.35253	.39199	.22298	1,79299	1,71317
27	303,75000	2,56579	.40196	-.60157	-.14164	.21315	-.36971	.36335	.43119	.22298	1,87230	1,73507
28	315,00000	2,56579	.51160	-.51160	-.14350	.30418	-.30418	.36701	.44503	.22298	1,90030	1,70246
29	326,25000	2,56579	.60157	-.40196	-.14164	.36971	-.21315	.36335	.43119	.22298	1,87230	1,73507
30	337,50000	2,56579	.66843	-.27687	-.17427	.40263	-.10695	.35253	.39199	.22298	1,79299	1,71317
31	348,75000	2,56579	.70941	-.14115	-.16748	.40006	.00223	.33495	.33372	.22298	1,67511	1,67761
32	360,00000	2,56579	.72351	.00000	-.15565	.36372	.10212	.31130	.26490	.22298	1,53589	1,62975

## BODY RINGE 3

1	11,25000	4,61842	1,06771	.21238	-.00033	.22574	.20086	.16066	.06989	.13346	1,14139	1,32501
2	22,50000	4,61842	1,00576	.41660	-.06880	.13775	.24102	.13359	.01221	.13346	1,02471	1,27026
3	33,75000	4,61842	.90516	.60481	-.05211	.04519	.24720	.10423	-.03411	.13346	.93100	1,21085
4	45,00000	4,61842	.76977	.76977	-.03484	-.03919	.22098	.07369	-.06712	.13346	.86423	1,14907
5	56,25000	4,61842	.60481	.90516	-.02157	-.10436	.16857	.04315	-.08669	.13346	.82863	1,08729
6	67,50000	4,61842	.41660	1,00576	-.00689	-.10264	.09977	.01378	-.09400	.13346	.80985	1,02788
7	78,75000	4,61842	.21238	1,06771	.00664	-.15070	.02641	-.01328	-.09112	.13346	.81567	.97313
8	90,00000	4,61842	.00000	1,06883	.01850	-.13008	-.03951	-.03701	-.08092	.13346	.83300	.92514
9	101,25000	4,61842	-.21238	1,06771	.02824	-.08677	-.08768	-.05647	-.06693	.13346	.86461	.88575
10	112,50000	4,61842	-.41660	1,00576	.03547	-.03020	-.11104	-.07094	-.05303	.13346	.89273	.85409
11	123,75000	4,61842	-.60481	.90516	.03992	-.10687	-.02825	-.07985	-.04295	.13346	.91124	.83847
12	135,00000	4,61842	-.76977	.76977	.04143	.07716	-.07716	-.08286	-.03916	.13346	.92073	.83238
13	146,25000	4,61842	-.90516	.60481	.03992	.10687	-.02825	-.07985	-.04295	.13346	.91374	.83847
14	157,50000	4,61842	1,00576	.41660	.03547	.11104	.05020	-.07094	-.05303	.13346	.91374	.83847
15	168,75000	4,61842	1,06771	.21238	.02824	.08768	.08677	-.05647	-.06693	.13346	.86461	.88575
16	180,00000	4,61842	1,06883	.00000	.01850	.13008	.03951	-.03701	-.08092	.13346	.83300	.92514
17	191,25000	4,61842	1,06771	-.21238	.00664	.15070	-.02641	-.01328	-.09112	.13346	.81567	.97313
18	202,50000	4,61842	1,00576	.41660	-.00689	.10264	.09977	.01378	-.09400	.13346	.80985	1,02788
19	213,75000	4,61842	.90516	.60481	-.02157	-.10436	.16857	.04315	-.08669	.13346	.82863	1,08729
20	225,00000	4,61842	.76977	.76977	-.03484	-.03919	.22098	.07369	-.06712	.13346	.86423	1,14907
21	236,25000	4,61842	.60481	.90516	-.05211	-.10423	.24720	.10423	-.03411	.13346	.93100	1,21085
22	247,50000	4,61842	.41660	1,00576	-.06880	-.13775	.24102	.13359	.01221	.13346	1,02471	1,27026
23	258,75000	4,61842	-.21238	1,06771	.00664	-.15070	.02641	-.01328	-.09112	.13346	1,14139	1,32501
24	270,00000	4,61842	.00000	1,06883	.01850	.13008	.03951	-.03701	-.08092	.13346	1,27215	1,37300
25	281,25000	4,61842	.21238	1,06771	-.10192	.03661	.33983	.20385	.19915	.13346	1,40288	1,41238
26	292,50000	4,61842	.41660	1,00576	-.10916	.08818	.34857	.21831	.25494	.13346	1,51574	1,40164
27	303,75000	4,61842	.60481	.90516	-.11361	.17108	.32064	.22722	.29296	.13346	1,59265	1,45967
28	315,00000	4,61842	.76977	.76977	-.11511	.25895	.23023	.30647	.30647	.13346	1,61998	1,48575
29	326,25000	4,61842	.90516	.60481	-.11361	.32064	.22722	.29296	.30647	.13346	1,59265	1,45967
30	337,50000	4,61842	1,00576	.41660	-.10916	.08818	.34857	.21831	.25494	.13346	1,51574	1,40164
31	348,75000	4,61842	1,06771	-.21238	-.10192	.03661	.33983	.20385	.19915	.13346	1,40288	1,41238
32	360,00000	4,61842	1,06883	.00000	-.09219	.29660	.13008	.18438	.13453	.13346	1,27215	1,37300

## BODY RINGE 4

1	11,25000	6,67105	1,24992	.24845	-.01697	.14328	.22303	.01394	-.06233	.04699	.87392	1,06887
2	22,50000	6,67105	1,17655	.48734	-.00804	.04966	.25004	.01608	-.10916	.00699	.77918	1,03254
3	33,75000	6,67105	1,05897	.70751	.00165	-.00565	.24017	-.00320	-.14409	.04699	.70850	.99334
4	45,00000	6,67105	.90049	.90049	.01172	-.12864	.19587	-.02345	-.14569	.04699	.60481	.95257
5	56,25000	6,67105	.70751	1,05897	.02180	-.18734	.12471	-.04368	-.17404	.04699	.64791	.91180
6	67,50000	6,67105	.48734	1,17655	.03144	-.21365	.03819	-.06298	-.17024	.04699	.65561	.87280
7	78,75000	6,67105	.24845	1,24992	.04042	-.26448	.05002	-.08080	-.15623	.04699	.68394	.83647
8	90,00000	6,67105	.00000	1,27349	.04825	-.31226	.12618	-.09649	-.13495	.04699	.72699	.80480

Figure 6.- Continued.

9	101,25000	6.67105	-.24445	1.24902	.05447	-.09444	-.17460	-.14934	-.11043	.04499	.77459	.77841
10	112,50000	6.67105	-.44734	1.17655	.05944	-.01246	-.19939	-.11888	-.04758	.04699	.82282	.75950
11	123,75000	6.67105	-.70751	1.05847	.06238	.07024	-.18570	-.12476	-.07135	.04699	.84546	.74761
12	135,00000	6.67105	-.90049	.90049	.06337	.14011	-.14011	-.12674	-.06347	.04699	.86744	.74359
13	146,25000	6.67105	-1.05847	.70751	.06238	.18570	-.07024	-.12476	-.07135	.04699	.85566	.74761
14	157,50000	6.67105	-1.17655	.44734	.05944	.19939	.01246	-.11888	-.04758	.04699	.82282	.75950
15	168,75000	6.67105	-1.24902	.24445	.05447	.17460	.09444	-.10934	-.11043	.04699	.77459	.77841
16	180,00000	6.67105	-1.27349	.00000	.04425	.12618	.16226	-.09649	-.13495	.04699	.72699	.80480
17	191,25000	6.67105	-1.24902	.24445	.05447	.17460	.09444	-.10934	-.11043	.04699	.77459	.77841
18	202,50000	6.67105	-1.17655	.44734	.05944	.19939	.01246	-.11888	-.04758	.04699	.82282	.75950
19	213,75000	6.67105	-1.05847	.70751	.06238	.18570	-.07024	-.12476	-.07135	.04699	.85566	.74761
20	225,00000	6.67105	-.90049	.90049	.06337	.14011	-.14011	-.12674	-.06347	.04699	.86744	.74359
21	236,25000	6.67105	-.70751	1.05847	.06238	.07024	-.18570	-.12476	-.07135	.04699	.84546	.74761
22	247,50000	6.67105	-.44734	1.17655	.05944	-.01246	-.19939	-.11888	-.04758	.04699	.82282	.75950
23	258,75000	6.67105	-.24445	1.24902	.05447	-.09444	-.17460	-.14934	-.11043	.04699	.77459	.77841
24	270,00000	6.67105	-.00000	1.27349	.04425	.12618	.16226	-.09649	-.13495	.04699	.72699	.80480
25	281,25000	6.67105	.24445	1.24902	.05447	-.09444	-.17460	-.14934	-.11043	.04699	.77459	.77841
26	292,50000	6.67105	.44734	1.17655	.05944	-.01246	-.19939	-.11888	-.04758	.04699	.82282	.75950
27	303,75000	6.67105	.70751	1.05847	.06238	.07024	-.18570	-.12476	-.07135	.04699	.84546	.74761
28	314,00000	6.67105	.90049	.90049	.06337	.14011	-.14011	-.12674	-.06347	.04699	.86744	.74359
29	326,25000	6.67105	1.05847	.70751	.06238	.18570	-.07024	-.12476	-.07135	.04699	.85566	.74761
30	337,50000	6.67105	1.17655	.44734	.05944	.19939	.01246	-.11888	-.04758	.04699	.82282	.75950
31	348,75000	6.67105	1.24902	.24445	.05447	.17460	.09444	-.10934	-.11043	.04699	.77459	.77841
32	360,00000	6.67105	1.27349	.00000	.04425	.12618	.16226	-.09649	-.13495	.04699	.72699	.80480

BODY RING= 5

BODY NOSE SEPARATION AT XB/RB = 5.52485  
 VORTEX STRENGTH GAMMA/(2\*PI\*RLOC\*VINF) = .07510  
 VORTEX Y/RLOC (UNROLLED COORDS) = .63291  
 VORTEX Z/RLOC (UNROLLED COORDS) = 1.17444

RIGHT VORTEX STRENGTH GAMMA/(2\*PI\*RLOC\*VINF) = .07510  
 RIGHT VORTEX Y(ROLLED COORDS.)/RLOC = .38327  
 RIGHT VORTEX Z(ROLLED COORDS.)/RLOC = 1.27835  
 LEFT VORTEX STRENGTH GAMMA/(2\*PI\*RLOC\*VINF) = -.07510  
 LEFT VORTEX Y(ROLLED COORDS.)/RLOC = -1.27835  
 LEFT VORTEX Z(ROLLED COORDS.)/RLOC = .38327

1	11,25000	8.72368	1.27502	.25362	.01844	.09244	.24186	-.03492	-.13846	0.00000	.71949	.92531
2	22,50000	8.72368	1.20104	.49749	.02098	-.00453	.25906	-.04195	-.17259	0.00000	.65086	.91513
3	33,75000	8.72368	1.08091	.72224	.02471	-.09954	.23510	-.04742	-.19340	0.00000	.60875	.90407
4	45,00000	8.72368	.91924	.91924	.02655	-.17601	.17601	-.05310	-.19873	0.00000	.59797	.89257
5	56,25000	8.72368	.72224	1.08091	.02939	-.21820	.08758	-.05879	-.18674	0.00000	.62223	.88108
6	67,50000	8.72368	.49749	1.20104	.03213	-.21115	.01551	-.06425	-.15486	0.00000	.64673	.87002
7	78,75000	8.72368	.25362	1.27502	.03464	-.13439	-.11342	-.06929	-.09967	0.00000	.70837	.85983
8	90,00000	8.72368	.00000	1.30000	.03685	.03919	-.17544	-.07370	-.02491	0.00000	.79340	.85090
9	101,25000	8.72368	-.25362	1.27502	.03866	.51798	-.14709	-.07733	-.03667	0.00000	.92543	.84357
10	112,50000	8.72368	-.49749	1.20104	.04001	.37297	-.09363	-.08002	-.04200	0.00000	.87458	.83812
11	123,75000	8.72368	-.72224	1.08091	.04084	.23609	-.13492	-.08168	-.02545	0.00000	.84852	.83477
12	135,00000	8.72368	-.91924	.91924	.04112	.17544	-.17544	-.08224	-.02079	0.00000	.94795	.83344
13	146,25000	8.72368	-1.08091	.72224	.04084	.13492	.23609	-.08168	-.02545	0.00000	.94852	.83477
14	157,50000	8.72368	-1.20104	.49749	.04001	.09363	.37297	-.08002	-.06240	0.00000	.87458	.83812
15	168,75000	8.72368	-1.27502	.25362	.03866	.14709	-.31798	-.07744	-.03667	0.00000	.92543	.84357
16	180,00000	8.72368	-1.30000	.00000	.03685	.17544	-.03919	-.07370	-.02491	0.00000	.94795	.85090
17	191,25000	8.72368	-1.27502	-.25362	.03464	.11342	.13639	-.06929	-.09967	0.00000	.70837	.85983

Figure 6.- Continued.



18	202,50000	8.72368	-1.26104	-.49749	.03213	.01531	.21115	-.06425	-.15486	0.00000	.68675	.87002
19	214,75000	8.72368	-1.08091	-.72224	.02439	-.04758	.21820	-.05879	-.18674	0.00000	.62223	.88104
20	225,00000	8.72368	-.91924	-.91924	.02655	-.17601	.17601	-.05310	-.19873	0.00000	.59797	.89257
21	236,25000	8.72368	-.72224	-1.08091	.02371	-.23610	.09954	-.07742	-.19400	0.00000	.68875	.90407
22	247,50000	8.72368	-.49749	-1.26104	.02098	-.25906	.00453	-.04195	-.17259	0.00000	.65086	.91513
23	258,75000	8.72368	-.25362	-1.27502	.01846	-.24186	-.09244	-.03692	-.13846	0.00000	.71989	.92531
24	270,00000	8.72368	.00000	-1.30000	.01625	-.18759	-.01754	-.03250	-.09467	0.00000	.80849	.93025
25	281,25000	8.72368	.25362	-1.27502	.01444	-.10449	-.23121	-.02888	-.04710	0.00000	.90072	.94157
26	292,50000	8.72368	.49749	-1.26104	.01309	-.00668	-.25088	-.02819	-.00372	0.00000	.99247	.94702
27	303,75000	8.72368	.72224	-1.08091	.01227	.09183	-.23132	-.02453	.02686	0.00000	1.05435	.95037
28	315,00000	8.72368	.91924	-.91924	.01199	.17544	-.17544	-.02397	.03792	0.00000	1.07671	.95151
29	326,25000	8.72368	1.08091	-.72224	.01227	.23132	-.09183	-.02453	.02686	0.00000	1.05435	.95037
30	337,50000	8.72368	1.26104	-.49749	.01309	.25088	.00668	-.02819	-.00372	0.00000	.99247	.94702
31	348,75000	8.72368	1.27502	-.25362	.01444	.24121	.10489	-.02888	-.04710	0.00000	.90072	.94157
32	360,00000	8.72368	1.30000	.00000	.01625	.17544	.18759	-.03250	-.09467	0.00000	.80849	.93025

## BODY RING#

BODY NOSE SEPARATION AT XB/RH = 5.52485  
 VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINF) = .07701  
 VORTEX Y/RLUC (UNROLLED CHORDS) = .63679  
 VORTEX Z/RLUC (UNROLLED CHORDS) = 1.22147

RIGHT VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINF) = .07701  
 RIGHT VORTEX Y/RLUC (UNROLLED CHORDS) = -.41343  
 RIGHT VORTEX Z/RLUC (UNROLLED CHORDS) = 1.31399  
 LEFT VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINF) = -.07701  
 LEFT VORTEX Y/RLUC (UNROLLED CHORDS) = -1.31399  
 LEFT VORTEX Z/RLUC (UNROLLED CHORDS) = -.41343

1	11,25000	10.77632	1.27502	.25362	.01723	.09187	.24573	-.03446	-.13919	0.00000	.71801	.93030
2	22,50000	10.77632	1.26104	.49749	.01669	-.00614	.26294	-.03338	-.16925	0.00000	.65760	.93247
3	33,75000	10.77632	1.08091	.72224	.01611	-.10186	.23957	-.03222	-.18568	0.00000	.62437	.93482
4	45,00000	10.77632	.91924	.91924	.01550	-.17871	.17871	-.03101	-.18601	0.00000	.62471	.93727
5	56,25000	10.77632	.72224	1.08091	.01490	-.22080	.08452	-.02980	-.16797	0.00000	.68019	.93972
6	67,50000	10.77632	.49749	1.26104	.01432	-.21334	-.01441	-.02863	-.12885	0.00000	.73975	.94207
7	78,75000	10.77632	.25362	1.27502	.01378	-.15943	-.11281	-.02758	-.08501	0.00000	.80849	.94424
8	90,00000	10.77632	.00000	1.30000	.01331	.02598	-.17544	-.02662	.01263	0.00000	1.02555	.94615
9	101,25000	10.77632	-.25362	1.27502	.01292	.27244	-.15615	-.02585	.02547	0.00000	1.05153	.94771
10	112,50000	10.77632	-.49749	1.26104	.01246	.34955	-.10333	-.02528	-.00024	0.00000	.99952	.94887
11	123,75000	10.77632	-.72224	1.08091	.01200	.24047	-.13199	-.02492	.03044	0.00000	1.06158	.94958
12	135,00000	10.77632	-.91924	.91924	.01240	.17544	-.17544	-.02480	.03706	0.00000	1.07697	.94982
13	146,25000	10.77632	-1.08091	.72224	.01296	.13199	-.24047	-.02492	.03044	0.00000	1.06158	.94958
14	157,50000	10.77632	-1.26104	.49749	.01240	.10333	-.34955	-.02528	-.00024	0.00000	.99952	.94887
15	168,75000	10.77632	-1.27502	.25362	.01292	.15615	-.27244	-.02585	.02547	0.00000	1.05153	.94771
16	180,00000	10.77632	-1.30000	.00000	.01331	.17544	-.02598	-.02662	.01263	0.00000	1.02555	.94615
17	191,25000	10.77632	-1.27502	-.25362	.01378	.11281	.13943	-.02758	-.06501	0.00000	.80849	.94424
18	202,50000	10.77632	-1.26104	-.49749	.01432	.01441	.21334	-.02863	-.12885	0.00000	.73975	.94207
19	213,75000	10.77632	-1.08091	-.72224	.01490	-.08452	.22080	-.02980	-.16797	0.00000	.68019	.93972
20	225,00000	10.77632	-.91924	-.91924	.01550	-.17871	.17871	-.03101	-.18601	0.00000	.62471	.93727
21	236,25000	10.77632	-.72224	1.08091	.01611	-.23957	.10186	-.03222	-.18568	0.00000	.62437	.93482
22	247,50000	10.77632	-.49749	1.26104	.01669	-.00614	.26294	-.03338	-.16925	0.00000	.65760	.93247
23	258,75000	10.77632	-.25362	1.27502	.01723	-.09187	.24573	-.03446	-.13919	0.00000	.71801	.93030
24	270,00000	10.77632	.00000	1.30000	.01770	.19104	-.17544	-.03540	-.09425	0.00000	.79922	.92830
25	281,25000	10.77632	.25362	1.27502	.01846	-.10759	-.23174	-.03617	-.05520	0.00000	.88853	.92683
26	292,50000	10.77632	.49749	1.26104	.01847	-.00846	-.25162	-.03674	-.01473	0.00000	.97021	.92567

Figure 6.- Continued.

27	303.75000	10.77632	.72224	-1.08091	.01855	.09101	-.25186	-.03709	.01392	0.00000	1.02817	.92496
28	315.00000	10.77632	.91924	-.91924	.01861	.17544	-.17544	-.03721	.02430	0.00000	1.04914	.92472
29	326.25000	10.77632	1.08091	-.72224	.01855	.25186	-.09101	-.03709	.01392	0.00000	1.02817	.92496
30	337.50000	10.77632	1.20104	-.49749	.01837	.25162	.00846	-.03674	-.01473	0.00000	.97021	.92567
31	348.75000	10.77632	1.27502	-.25362	.01808	.25174	.10759	-.03617	-.05520	0.00000	.88833	.92683
32	360.00000	10.77632	1.30000	.00000	.01770	.17544	.18104	-.03540	-.09925	0.00000	.79922	.92839

HDDY PTNG = 7

HDDY NOISE SEPARATION AT XB/RH = 5.52485  
 VORTEX STRENGTH GAMMA/(2\*PI\*RLOC\*VINP) = .07893  
 VORTEX Y/RLOC (UNROLLED COORDS) = .84087  
 VORTEX Z/RLOC (UNROLLED COORDS) = 1.26800

RIGHT VORTEX STRENGTH GAMMA/(2\*PI\*RLOC\*VINP) = .07691  
 RIGHT VORTEX Y(ROLLED COORDS)/RLOC = -.40323  
 RIGHT VORTEX Z(ROLLED COORDS)/RLOC = 1.34977  
 LEFT VORTEX STRENGTH GAMMA/(2\*PI\*RLOC\*VINP) = -.07891  
 LEFT VORTEX Y(ROLLED COORDS)/RLOC = -1.34977  
 LEFT VORTEX Z(ROLLED COORDS)/RLOC = .40323

1	11.25000	12.82895	-1.27502	.25362	.01334	.09328	.23765	-.02672	-.12754	0.00000	.74199	.94594
2	22.50000	12.82895	1.20104	.49749	.01226	-.00257	.25433	-.02452	-.15614	0.00000	.68412	.95039
3	33.75000	12.82895	1.08091	.72224	.01107	-.09622	.23113	-.02214	-.17124	0.00000	.65359	.95522
4	45.00000	12.82895	.91924	.91924	.00983	-.17112	.17112	-.01965	-.17022	0.00000	.65564	.96074
5	56.25000	12.82895	.72224	1.08091	.00858	-.21166	.08321	-.01717	-.15079	0.00000	.69495	.96527
6	67.50000	12.82895	.49749	1.20104	.00739	-.20346	-.01850	-.01478	-.11026	0.00000	.77695	.97010
7	78.75000	12.82895	.25362	1.27502	.00629	-.13127	-.11444	-.01258	-.04674	0.00000	.89544	.97455
8	90.00000	12.82895	.00000	1.30000	.00533	-.02363	-.17544	-.01065	-.02799	0.00000	1.05663	.97885
9	101.25000	12.82895	-.25362	1.27502	.00454	.24321	-.16196	-.00907	.04810	0.00000	1.09731	.98165
10	112.50000	12.82895	-.49749	1.20104	.00395	.32994	-.11145	-.00790	.02477	0.00000	1.05012	.98403
11	123.75000	12.82895	-.72224	1.08091	.00359	.24358	-.12992	-.00717	.04813	0.00000	1.09736	.98549
12	135.00000	12.82895	-.91924	.91924	.00346	-.17544	-.17544	-.00693	.05568	0.00000	1.11264	.98599
13	146.25000	12.82895	-1.08091	.72224	.00359	-.12992	-.24358	-.00717	.04813	0.00000	1.09736	.98549
14	157.50000	12.82895	-1.20104	.49749	.00395	.11145	-.32994	-.00790	.02477	0.00000	1.05012	.98403
15	168.75000	12.82895	-1.27502	.25362	.00454	.16196	-.24321	-.00907	.04810	0.00000	1.09731	.98165
16	180.00000	12.82895	-1.30000	.00000	.00533	.17544	-.02363	-.01065	.02799	0.00000	1.05663	.97885
17	191.25000	12.82895	-1.27502	-.25362	.00629	.11444	.13127	-.01258	-.04674	0.00000	.89544	.97455
18	202.50000	12.82895	-1.20104	-.49749	.00739	.01850	.20346	-.01478	-.11026	0.00000	.77695	.97010
19	213.75000	12.82895	-1.08091	.72224	.00858	-.08321	.21166	-.01717	-.15079	0.00000	.69495	.96527
20	225.00000	12.82895	-.91924	.91924	.00983	-.17112	.17112	-.01965	-.17022	0.00000	.65564	.96074
21	236.25000	12.82895	-.72224	1.08091	.01107	-.09622	.23113	-.02214	-.17124	0.00000	.65359	.95522
22	247.50000	12.82895	-.49749	1.20104	.01226	-.25433	.00257	-.02452	-.15614	0.00000	.68412	.95039
23	258.75000	12.82895	-.25362	1.27502	.01334	-.23765	-.09328	-.02672	-.12754	0.00000	.74199	.94594
24	270.00000	12.82895	.00000	1.30000	.01433	-.18411	-.17544	-.02865	-.08923	0.00000	.81948	.94204
25	281.25000	12.82895	.25362	1.27502	.01512	-.10230	-.24069	-.03023	-.04694	0.00000	.94503	.93844
26	292.50000	12.82895	.49749	1.20104	.01570	-.00504	-.25020	-.03141	-.00813	0.00000	.98356	.93499
27	303.75000	12.82895	.72224	1.08091	.01607	.09257	-.23082	-.03213	.01932	0.00000	1.03909	.93099
28	315.00000	12.82895	.91924	.91924	.01619	.17544	-.17544	-.03238	.02925	0.00000	1.05918	.93499
29	326.25000	12.82895	1.08091	.72224	.01607	.25082	-.09257	-.03213	.01932	0.00000	1.03909	.93099
30	337.50000	12.82895	1.20104	.49749	.01570	.25020	.00504	-.03141	-.00813	0.00000	.98356	.93499
31	348.75000	12.82895	1.27502	-.25362	.01512	.23069	.10230	-.03023	-.04694	0.00000	.94503	.93844
32	360.00000	12.82895	1.30000	.00000	.01433	.17544	.18411	-.02865	-.08923	0.00000	.81948	.94204

Figure 6.- Continued.

BODY RING 6

BODY NOSE SEPARATION AT XB/RH = 5.52485  
 VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINF) = .08082  
 VORTEX Y/RLUC (UNROLLED COORDS) = .64591  
 VORTEX Z/RLUC (UNROLLED COORDS) = 1.31453

RIGHT VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINF) = .08082  
 RIGHT VORTEX Y(ROLLED COORDS,)/RLUC = -.47279  
 RIGHT VORTEX Z(ROLLED COORDS,)/RLUC = 1.38624  
 LEFT VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINF) = -.08082  
 LEFT VORTEX Y(ROLLED COORDS,)/RLUC = -1.38624  
 LEFT VORTEX Z(ROLLED COORDS,)/RLUC = .47279

1	11.25000	14.88158	1.27502	.25362	.00928	.09490	.22906	-.01855	-.11532	0.00000	.76670	.96247
2	22.50000	14.88158	1.20104	.49749	.00844	.00103	.24562	-.01691	-.14371	0.00000	.70927	.96579
3	33.75000	14.88158	1.08091	.72224	.00757	-.09054	.22262	-.01513	-.15873	0.00000	.67888	.96930
4	45.00000	14.88158	.91924	.91924	.00664	-.16351	.16351	-.01328	-.15776	0.00000	.68084	.97314
5	56.25000	14.88158	.72224	1.08091	.00571	-.20255	.07712	-.01143	-.13858	0.00000	.71965	.97689
6	67.50000	14.88158	.49749	1.20104	.00482	-.19377	-.02251	-.00964	-.09890	0.00000	.79993	.98049
7	78.75000	14.88158	.25362	1.27502	.00400	-.12339	-.11600	-.00800	-.03793	0.00000	.92326	.98381
8	90.00000	14.88158	-.00000	1.30000	.00328	.02217	-.17504	-.00656	.03169	0.00000	1.06410	.98672
9	101.25000	14.88158	-.25362	1.27502	.00249	.22012	-.16656	-.00538	.05492	0.00000	1.11111	.98911
10	112.50000	14.88158	-.49749	1.20104	.00225	.31040	-.11955	-.00451	.03517	0.00000	1.07114	.99089
11	123.75000	14.88158	-.72224	1.08091	.00198	.24356	-.12993	-.00397	.05147	0.00000	1.10412	.99198
12	135.00000	14.88158	-.91924	.91924	.00180	.17544	-.17544	-.00378	.05899	0.00000	1.11933	.99235
13	146.25000	14.88158	-1.08091	.72224	.00198	.12993	-.24356	-.00347	.05147	0.00000	1.16412	.99198
14	157.50000	14.88158	-1.20104	.49749	.00225	.11955	-.31040	-.00451	.03517	0.00000	1.07114	.99089
15	168.75000	14.88158	-1.27502	.25362	.00249	.16656	-.22012	-.00538	.05492	0.00000	1.11111	.98911
16	180.00000	14.88158	-1.30000	-.00000	.00328	.17544	-.02217	-.00656	.03169	0.00000	1.06410	.98672
17	191.25000	14.88158	-1.27502	-.25362	.00400	.11600	.12339	-.00800	-.03793	0.00000	.92326	.98381
18	202.50000	14.88158	-1.20104	-.49749	.00482	.02251	.19377	-.00964	-.09890	0.00000	.79993	.98049
19	213.75000	14.88158	-1.08091	-.72224	.00571	-.07712	.20255	-.01143	-.13858	0.00000	.71965	.97689
20	225.00000	14.88158	-.91924	-.91924	.00664	-.16351	.16351	-.01328	-.15776	0.00000	.68084	.97314
21	236.25000	14.88158	-.72224	-1.08091	.00757	-.22262	.09054	-.01513	-.15873	0.00000	.67888	.96930
22	247.50000	14.88158	-.49749	-1.20104	.00844	-.24562	-.00103	-.01691	-.14371	0.00000	.70927	.96579
23	258.75000	14.88158	-.25362	-1.27502	.00928	-.22906	-.09490	-.01855	-.11532	0.00000	.76670	.96247
24	270.00000	14.88158	-.00000	-1.30000	.01000	-.17709	-.17544	-.01999	-.07743	0.00000	.84337	.95956
25	281.25000	14.88158	.25362	-1.27502	.01059	-.09693	-.22962	-.02117	-.03571	0.00000	.92775	.95717
26	292.50000	14.88158	.49749	-1.20104	.01102	-.00157	-.24877	-.02205	.00247	0.00000	1.00500	.95539
27	303.75000	14.88158	.72224	-1.08091	.01130	.09416	-.22976	-.02259	.02942	0.00000	1.05952	.95330
28	315.00000	14.88158	.91924	-.91924	.01139	.17544	-.17544	-.02277	.03916	0.00000	1.10922	.95393
29	326.25000	14.88158	1.08091	-.72224	.01130	.22976	-.09416	-.02259	.02942	0.00000	1.05952	.95330
30	337.50000	14.88158	1.20104	-.49749	.01102	.24877	.00157	-.02205	.00247	0.00000	1.00500	.95539
31	348.75000	14.88158	1.27502	-.25362	.01059	.22962	.09693	-.02117	-.03571	0.00000	.92775	.95717
32	360.00000	14.88158	1.30000	.00000	.01000	.17544	.17709	-.01999	-.07743	0.00000	.84337	.95956

BODY RING 9

BODY NOSE SEPARATION AT XB/RH = 5.52485  
 VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINF) = .08272  
 VORTEX Y/RLUC (UNROLLED COORDS) = .65095  
 VORTEX Z/RLUC (UNROLLED COORDS) = 1.36106

Figure 6.- Continued.

	11.25000	16.93421	1.27502	.25362	.00617	.09596	.22413	-.01234	-.10656	0.00000	.78443	.97504
2	22.50000	16.93421	1.20104	.49749	.00572	.00339	.23992	-.01144	-.13511	0.00000	.72668	.97687
3	33.75000	16.93421	1.00091	.72224	.00523	-.00478	.21701	-.01046	-.15036	0.00000	.69542	.97884
4	45.00000	16.93421	.91924	.91924	.00472	-.15845	.15845	-.00944	-.14971	0.00000	.69714	.98090
5	56.25000	16.93421	.72224	1.00091	.00421	-.19447	.07306	-.00442	-.13103	0.00000	.73493	.98296
6	67.50000	16.93421	.49749	1.20104	.00372	-.16740	-.02515	-.00745	-.09241	0.00000	.81306	.98493
7	78.75000	16.93421	.25362	1.27502	.00327	-.11886	-.11690	-.00655	-.03396	0.00000	.93130	.98676
8	90.00000	16.93421	.00000	1.50000	.00288	-.01863	-.17544	-.00576	.03137	0.00000	1.04446	.98835
9	101.25000	16.93421	-.25362	1.27502	.00245	.19451	-.17066	-.00511	.05687	0.00000	1.11504	.98966
10	112.50000	16.93421	-.49749	1.20104	.00231	.29103	-.12757	-.00463	.04108	0.00000	1.00311	.99064
11	123.75000	16.93421	-.72224	1.00091	.00217	.24097	-.11166	-.00433	.05163	0.00000	1.10445	.99124
12	135.00000	16.93421	-.91924	.91924	.00212	.17544	-.17544	-.00423	.05852	0.00000	1.11838	.99144
13	146.25000	16.93421	-1.00091	.72224	.00217	.13166	-.24097	-.00433	.05163	0.00000	1.10445	.99124
14	157.50000	16.93421	-1.20104	.49749	.00231	.12757	-.29103	-.00463	.04108	0.00000	1.00311	.99064
15	168.75000	16.93421	-1.27502	.25362	.00255	.17066	-.19951	-.00511	.05687	0.00000	1.11504	.98966
16	180.00000	16.93421	-1.50000	.00000	.00288	.17544	-.01863	-.00576	.03137	0.00000	1.04446	.98835
17	191.25000	16.93421	-1.27502	-.25362	.00327	.11886	-.11690	-.00655	-.03396	0.00000	.93130	.98676
18	202.50000	16.93421	-1.20104	-.49749	.00372	.02515	.16740	-.00745	-.09241	0.00000	.81306	.98493
19	213.75000	16.93421	-1.00091	-.72224	.00421	-.07306	.19447	-.00442	-.13103	0.00000	.73493	.98296
20	225.00000	16.93421	-.91924	-.91924	.00472	-.15845	.15845	-.00944	-.14971	0.00000	.69714	.98090
21	236.25000	16.93421	-.72224	-1.00091	.00523	-.21701	.04678	-.01046	-.15036	0.00000	.69542	.97884
22	247.50000	16.93421	-.49749	-1.20104	.00572	-.23992	-.00339	-.01144	-.13511	0.00000	.72668	.97687
23	258.75000	16.93421	-.25362	-1.27502	.00617	-.22413	-.09596	-.01234	-.10656	0.00000	.78443	.97504
24	270.00000	16.93421	.00000	-1.50000	.00656	-.17544	-.17544	-.01313	-.00861	0.00000	.84120	.97345
25	281.25000	16.93421	.25362	-1.27502	.00699	-.09346	-.22893	-.01377	-.02695	0.00000	.94547	.97116
26	292.50000	16.93421	.49749	-1.20104	.00713	.00066	-.24784	-.01426	.01110	0.00000	1.02245	.97116
27	303.75000	16.93421	.72224	-1.00091	.00728	.09518	-.22908	-.01455	.03792	0.00000	1.07670	.97056
28	315.00000	16.93421	.91924	-.91924	.00733	.17544	-.17544	-.01465	.04760	0.00000	1.09674	.97036
29	326.25000	16.93421	1.00091	-.72224	.00728	.22908	-.09518	-.01455	.03792	0.00000	1.07670	.97056
30	337.50000	16.93421	1.20104	-.49749	.00713	.24784	-.00066	-.01426	.01110	0.00000	1.02245	.97116
31	348.75000	16.93421	1.27502	-.25362	.00699	.22893	.09346	-.01377	-.02695	0.00000	.94547	.97116
32	360.00000	16.93421	1.50000	.00000	.00656	.17544	.17254	-.01313	-.00861	0.00000	.84120	.97345

BODY RING= 10

BODY NOSE SEPARATION AT YH/WH = 5.52485  
 VORTEX STRENGTH GAMMA/(2\*PI\*RLNC\*VINF) = .00688  
 VORTEX Y/RLNC (UNROLLED COORDS) = .65574  
 VORTEX Z/RLNC (UNROLLED COORDS) = 1.40759

RIGHT VORTEX STRENGTH GAMMA/(2\*PI\*RLNC\*VINF) = .00688  
 RIGHT VORTEX Y(ROLLED COORDS)/RLNC = -.53163  
 RIGHT VORTEX Z(ROLLED COORDS)/RLNC = 1.45901  
 LEFT VORTEX STRENGTH GAMMA/(2\*PI\*RLNC\*VINF) = -.00688  
 LEFT VORTEX Y(ROLLED COORDS)/RLNC = -1.45901  
 LEFT VORTEX Z(ROLLED COORDS)/RLNC = .53163

	11.25000	18.98684	1.27502	.25362	.00416	.09660	.22095	-.00832	-.10104	0.00000	.79560	.98318
2	22.50000	18.98684	1.20104	.49749	.00395	.00445	.23640	-.00791	-.12464	0.00000	.73774	.98401
3	33.75000	18.98684	1.00091	.72224	.00373	-.00430	.21339	-.00746	-.14474	0.00000	.70679	.98491
4	45.00000	18.98684	.91924	.91924	.00350	-.15498	.15498	-.00700	-.14430	0.00000	.70669	.98540

Figure 6.- Continued.

5	56.25000	18.98684	.72224	1.08091	.00427	-.19196	.07004	-.00653	-.12567	0.00000	.74577	.98678
6	67.50000	18.98684	.49749	1.20104	.00304	-.18211	-.02734	-.00609	-.08742	0.00000	.82115	.98764
7	78.75000	18.98684	.25362	1.27502	.00284	-.11411	-.11785	-.00568	-.03043	0.00000	.93844	.98851
8	90.00000	18.98684	-.00000	1.30000	.00264	-.01843	-.17544	-.00532	-.03175	0.00000	1.06423	.98924
9	101.25000	18.98684	-.25362	1.27502	.00244	.18801	-.17295	-.00503	.05746	0.00000	1.11625	.98943
10	112.50000	18.98684	-.49749	1.20104	.00224	.27961	-.13230	-.00481	.04404	0.00000	1.08910	.99028
11	123.75000	18.98684	-.72224	1.08091	.00204	.24039	-.13205	-.00467	.05139	0.00000	1.10397	.99055
12	135.00000	18.98684	-.91924	.91924	.00231	.17544	-.17544	-.00463	.05810	0.00000	1.11754	.99064
13	146.25000	18.98684	-1.08091	.72224	.00234	.13205	-.24039	-.00467	.05139	0.00000	1.10397	.99055
14	157.50000	18.98684	-1.20104	.49749	.00240	.11230	-.27961	-.00481	.04404	0.00000	1.08910	.99028
15	168.75000	18.98684	-1.27502	.25362	.00251	.17295	-.18801	-.00503	.05746	0.00000	1.11625	.98943
16	180.00000	18.98684	-1.30000	-.00000	.00264	.17544	-.01843	-.00532	.03175	0.00000	1.06423	.98924
17	191.25000	18.98684	-1.27502	-.25362	.00284	.11785	.11411	-.00568	-.03043	0.00000	.93844	.98851
18	202.50000	18.98684	-1.20104	-.49749	.00304	.02734	.18211	-.00609	-.08742	0.00000	.82115	.98764
19	213.75000	18.98684	-1.08091	-.72224	.00327	-.07004	.19196	-.00653	-.12567	0.00000	.74577	.98678
20	225.00000	18.98684	-.91924	-.91924	.00350	-.15498	.15498	-.00720	-.14030	0.00000	.70609	.98580
21	236.25000	18.98684	-.72224	-1.08091	.00373	-.21339	.08436	-.00746	-.14494	0.00000	.70679	.98491
22	247.50000	18.98684	-.49749	-1.20104	.00395	-.23640	-.00485	-.00791	-.12464	0.00000	.73774	.98401
23	258.75000	18.98684	-.25362	-1.27502	.00416	-.22095	-.00640	-.00832	-.10104	0.00000	.79560	.98318
24	270.00000	18.98684	.00000	-1.30000	.00434	-.16989	-.17544	-.00867	-.06304	0.00000	.87247	.98245
25	281.25000	18.98684	.25362	-1.27502	.00448	-.09147	-.22854	-.00897	-.02137	0.00000	.95677	.98185
26	292.50000	18.98684	.49749	-1.20104	.00459	.00193	-.24732	-.00919	.01666	0.00000	1.03371	.98141
27	303.75000	18.98684	.72224	-1.08091	.00466	.04575	-.22869	-.00932	.04345	0.00000	1.08790	.98114
28	315.00000	18.98684	.91924	-.91924	.00468	.17544	-.17544	-.00937	.04312	0.00000	1.10746	.98105
29	326.25000	18.98684	1.08091	-.72224	.00466	.22869	-.09575	-.00932	.04345	0.00000	1.08790	.98114
30	337.50000	18.98684	1.20104	-.49749	.00459	.24732	-.00193	-.00919	.01666	0.00000	1.03371	.98141
31	348.75000	18.98684	1.27502	-.25362	.00448	.27854	.09147	-.00897	-.02137	0.00000	.95677	.98185
32	360.00000	18.98684	1.30000	.00000	.00434	.17544	.16989	-.00867	-.06304	0.00000	.87247	.98245

TOTAL NUMBER OF PRESSURE POINTS JCPT= 428

CONTROL POINT COORDINATES FOR 3 CHORDWISE BY 5 SPANWISE PANELS ON WING 1 OR W, 5 SPANWISE ON WING 2 OR L AND 5 SPANWISE PANELS ON WING 3 OR U, 5 SPANWISE ON WING 4 OR D

J	X(J)	Y(J)	Z(J)	RU(J)	HV(J)	HW(J)	VVRTX	WVRTX
1	1.25112	1.53096	0.00000	.30415E+02	.12609E+00	.12789E+00	0.	0.
2	2.38667	1.53096	0.00000	.25619E+02	.12617E+00	.12768E+00	0.	0.
3	3.54222	1.53096	0.00000	.22035E+02	.12622E+00	.12755E+00	0.	0.
4	1.41565	1.99870	0.00000	.30173E+02	.73266E+01	.75357E+01	0.	0.
5	2.48114	1.99870	0.00000	.25478E+02	.73453E+01	.75200E+01	0.	0.
6	3.54672	1.99870	0.00000	.22281E+02	.73581E+01	.75098E+01	0.	0.
7	1.60017	2.46640	0.00000	.30518E+02	.47405E+01	.49788E+01	0.	0.
8	2.57570	2.46640	0.00000	.26235E+02	.47650E+01	.49633E+01	0.	0.
9	1.55122	2.46640	0.00000	.22924E+02	.47827E+01	.49541E+01	0.	0.
10	1.78466	2.93403	0.00000	.31062E+02	.32808E+01	.35417E+01	0.	0.
11	2.67019	2.93403	0.00000	.26949E+02	.33091E+01	.35293E+01	0.	0.
12	3.55572	2.93403	0.00000	.23729E+02	.33299E+01	.35206E+01	0.	0.
13	1.96912	3.40158	0.00000	.32017E+02	.23701E+01	.26577E+01	0.	0.
14	2.76467	3.40158	0.00000	.28029E+02	.24011E+01	.26461E+01	0.	0.
15	3.56022	3.40158	0.00000	.24715E+02	.24266E+01	.26377E+01	0.	0.
16	1.25112	-1.53096	0.00000	.25353E+02	.12635E+00	.12789E+00	0.	0.
17	2.38667	-1.53096	0.00000	.21254E+02	.12618E+00	.12788E+00	0.	0.
18	3.54222	-1.53096	0.00000	.19174E+02	.12640E+00	.12754E+00	0.	0.
19	1.41565	-1.99870	0.00000	.22883E+02	.73472E+01	.75357E+01	0.	0.
20	2.48114	-1.99870	0.00000	.21091E+02	.70042E+01	.75200E+01	0.	0.

Figure 6.- Continued.

21	3.54672	-1.99487	0.00000	19229E-02	74077E-01	75098E-01	0.	0.
22	1.60017	-2.46640	0.00000	21940E-02	48455E-01	49764E-01	0.	0.
23	2.57570	-2.46640	0.00000	20524E-02	48538E-01	49633E-01	0.	0.
24	3.55122	-2.46640	0.00000	18949E-02	48586E-01	49541E-01	0.	0.
25	1.78666	-2.93403	0.00000	21404E-02	34196E-01	35417E-01	0.	0.
26	2.67019	-2.93403	0.00000	20174E-02	34274E-01	35294E-01	0.	0.
27	3.55572	-2.93403	0.00000	18423E-02	34317E-01	35206E-01	0.	0.
28	1.96912	-3.40158	0.00000	20349E-02	24577E-01	25461E-01	0.	0.
29	2.76467	-3.40158	0.00000	19547E-02	24461E-01	25405E-01	0.	0.
30	3.56022	-3.40158	0.00000	18804E-02	24558E-01	25377E-01	0.	0.
31	1.23112	0.00000	1.53096	23343E-02	-1.2789E+00	-1.2635E+00	0.	0.
32	2.38667	0.00000	1.53096	21254E-02	-1.2768E+00	-1.2635E+00	0.	0.
33	3.54222	0.00000	1.53096	19174E-02	-1.2755E+00	-1.2640E+00	0.	0.
34	1.41565	0.00000	1.99870	22884E-02	-75357E-01	-73972E-01	0.	0.
35	2.48119	0.00000	1.99870	21091E-02	-75200E-01	-74002E-01	0.	0.
36	3.54672	0.00000	1.99870	19229E-02	-75098E-01	-74077E-01	0.	0.
37	1.60017	0.00000	2.46640	21048E-02	-49764E-01	-48455E-01	0.	0.
38	2.57570	0.00000	2.46640	20524E-02	-49633E-01	-48538E-01	0.	0.
39	3.55122	0.00000	2.46640	18949E-02	-49541E-01	-48586E-01	0.	0.
40	1.78666	0.00000	2.93403	21404E-02	-35417E-01	-34196E-01	0.	0.
41	2.67019	0.00000	2.93403	20174E-02	-35294E-01	-34274E-01	0.	0.
42	3.55572	0.00000	2.93403	18423E-02	-35206E-01	-34317E-01	0.	0.
43	1.96912	0.00000	3.40158	20349E-02	-25477E-01	-25461E-01	0.	0.
44	2.76467	0.00000	3.40158	19547E-02	-25461E-01	-25405E-01	0.	0.
45	3.56022	0.00000	3.40158	18804E-02	-25377E-01	-25358E-01	0.	0.
46	1.23112	0.00000	-1.53096	30415E-02	-1.2789E+00	-1.2608E+00	0.	0.
47	2.38667	0.00000	-1.53096	28419E-02	-1.2768E+00	-1.2617E+00	0.	0.
48	3.54222	0.00000	-1.53096	22034E-02	-1.2755E+00	-1.2622E+00	0.	0.
49	1.41565	0.00000	-1.99870	30113E-02	-75357E-01	-74266E-01	0.	0.
50	2.48119	0.00000	-1.99870	28678E-02	-75200E-01	-73453E-01	0.	0.
51	3.54672	0.00000	-1.99870	22281E-02	-75098E-01	-73581E-01	0.	0.
52	1.60017	0.00000	-2.46640	30518E-02	-49768E-01	-47405E-01	0.	0.
53	2.57570	0.00000	-2.46640	28235E-02	-49633E-01	-47650E-01	0.	0.
54	3.55122	0.00000	-2.46640	22924E-02	-49541E-01	-47827E-01	0.	0.
55	1.78666	0.00000	-2.93403	31062E-02	-35417E-01	-34038E-01	0.	0.
56	2.67019	0.00000	-2.93403	26945E-02	-35293E-01	-33094E-01	0.	0.
57	3.55572	0.00000	-2.93403	23729E-02	-35206E-01	-33249E-01	0.	0.
58	1.96912	0.00000	-3.40158	32017E-02	-25577E-01	-23701E-01	0.	0.
59	2.76467	0.00000	-3.40158	28029E-02	-25461E-01	-24011E-01	0.	0.
60	3.56022	0.00000	-3.40158	24715E-02	-25377E-01	-24266E-01	0.	0.

CONTROL POINT COORDINATES FOR HIP-9 (WING FRAME)

J	X(J)	Y(J)	Z(J)	THU(J)	THV(J)	THW(J)
61	1.14000	1.25052	24874	-1.13891E-02	-1.18221E-01	34655E-02
62	1.14000	1.06014	70836	-1.15717E-01	88792E-02	20553E-01
63	1.14000	70836	1.06014	-1.15717E-01	20553E-01	-88792E-02
64	1.14000	24874	1.25052	-1.13891E-02	34655E-02	-1.18221E-01
65	1.14000	-24874	1.25052	-1.13891E-02	-34655E-02	-1.18221E-01
66	1.14000	-70836	1.06014	-1.15717E-01	-88792E-02	20553E-01
67	1.14000	-1.06014	70836	-1.15717E-01	88792E-02	20553E-01
68	1.14000	-1.25052	24874	-1.13891E-02	-1.18221E-01	34655E-02
69	1.14000	-1.25052	-24874	-1.13891E-02	1.18221E-01	-34655E-02
70	1.14000	-1.06014	-70836	-1.15717E-01	88792E-02	-20553E-01

Figure 6.- Continued.

71	1.14000	-.70846	-1.06014	-.15717E-01	-.20553E-01	.8A792E-02
72	1.14000	-.24874	-1.25052	-.13401E-02	-.10645E-02	.1A221E-01
73	1.14000	.24874	-1.25052	-.13401E-02	-.10645E-02	.1A221E-01
74	1.14000	.70846	-1.06014	-.15717E-01	-.20553E-01	.8A792E-02
75	1.14000	1.06014	-.70846	-.15717E-01	-.20553E-01	.8A792E-02
76	1.14000	1.25052	-.24874	-.13401E-02	-.10645E-02	.1A221E-01
77	2.34000	1.25052	.24874	-.10617E-01	-.8A355E-02	.4A355E-02
78	2.34000	1.06014	.70846	-.22211E-01	-.1A042E-01	.6A216E-02
79	2.34000	.70846	1.06014	-.22211E-01	-.1A042E-01	.6A216E-02
80	2.34000	-.24874	1.25052	-.10617E-01	-.8A355E-02	.4A355E-02
81	2.34000	-.24874	1.25052	-.10617E-01	-.8A355E-02	.4A355E-02
82	2.34000	-.70846	1.06014	-.22211E-01	-.1A042E-01	.6A216E-02
83	2.34000	-1.06014	.70846	-.22211E-01	-.1A042E-01	.6A216E-02
84	2.34000	-1.25052	.24874	-.10617E-01	-.8A355E-02	.4A355E-02
85	2.34000	-1.25052	.24874	-.10617E-01	-.8A355E-02	.4A355E-02
86	2.34000	-1.06014	.70846	-.22211E-01	-.1A042E-01	.6A216E-02
87	2.34000	-.70846	1.06014	-.22211E-01	-.1A042E-01	.6A216E-02
88	2.34000	-.24874	1.25052	-.10617E-01	-.8A355E-02	.4A355E-02
89	2.34000	.24874	-1.25052	-.10617E-01	-.8A355E-02	.4A355E-02
90	2.34000	.70846	-1.06014	-.22211E-01	-.1A042E-01	.6A216E-02
91	2.34000	1.06014	-.70846	-.22211E-01	-.1A042E-01	.6A216E-02
92	2.34000	1.25052	-.24874	-.10617E-01	-.8A355E-02	.4A355E-02
93	3.54000	1.25052	.24874	.20323E-01	.54507E-01	.2A782E-01
94	3.54000	1.06014	.70846	-.22211E-01	.11295E-01	.6A311E-02
95	3.54000	.70846	1.06014	-.22211E-01	.11295E-01	.6A311E-02
96	3.54000	.24874	1.25052	.20323E-01	.54507E-01	.2A782E-01
97	3.54000	-.24874	1.25052	.20323E-01	.54507E-01	.2A782E-01
98	3.54000	-.70846	1.06014	-.22211E-01	.11295E-01	.6A311E-02
99	3.54000	-1.06014	.70846	-.22211E-01	.11295E-01	.6A311E-02
100	3.54000	-1.25052	.24874	.20323E-01	.54507E-01	.2A782E-01
101	3.54000	-1.25052	.24874	.20323E-01	.54507E-01	.2A782E-01
102	3.54000	-1.06014	.70846	-.22211E-01	.11295E-01	.6A311E-02
103	3.54000	-.70846	1.06014	-.22211E-01	.11295E-01	.6A311E-02
104	3.54000	-.24874	1.25052	.20323E-01	.54507E-01	.2A782E-01
105	3.54000	.24874	-1.25052	.20323E-01	.54507E-01	.2A782E-01
106	3.54000	.70846	-1.06014	-.22211E-01	.11295E-01	.6A311E-02
107	3.54000	1.06014	-.70846	-.22211E-01	.11295E-01	.6A311E-02
108	3.54000	1.25052	-.24874	.20323E-01	.54507E-01	.2A782E-01

## LOADING INFORMATION

MACH NUMBER = .17000E+01  
 ANGLE OF ATTACK = 10.000 DEGREES  
 SIDE SLIP ANGLE = 10.000 DEGREES  
 WING AREA = 13.44000  
 REFERENCE AREA = 4.30000  
 REFERENCE LENGTH = 2.40000  
 EXPOSED WING SPAN = 2.40000  
 MOMENT CENTER XM = 12.50000  
 ZM = 0.00000

LIFTING TYPE LIFTING PRESSURE

Figure 6.- Continued.

OFFL. ANGLE DEG. =	TOTAL	FIN 1 OR R	FIN 2 OR L	FIN 3 OR U	FIN 4 OR D	INTERF. SPFL
CTMR =	.43832E+01	.15958E+01	.15958E+01	.15958E+01	.15958E+01	.25832E+00
CZ =	.15749E+01	.66031E+00	.66031E+00	0.	0.	.25832E+00
CY =	-.15749E+01	0.	0.	-.66031E+00	-.66031E+00	.28514E+00
CM =	-.15743E+01	-.64660E+00	-.64660E+00	0.	0.	.28514E+00
CLN =	.15743E+01	0.	0.	.64660E+00	.64660E+00	.28514E+00
CIL =	.17047E+14	-.57494E+00	.57494E+00	-.57494E+00	.57494E+00	.24094E-15

FOLLOWING ARE IN WIND-AXIS SYSTEM

CI =	.21803E+01	.45653E+00	.45653E+00	.45653E+00	.45653E+00	.35414E+00
CY-IND =	.76117E+12	.46691E+00	.46691E+00	-.46691E+00	-.46691E+00	.72387E-12
COI =	.48649E+00	.99193E+01	.49193E+01	.49193E+01	.99193E+01	.89715E+01
COI/CL*P =	.10234E+00					
CM-IND =	-.22321E+01	-.45721E+00	-.45721E+00	-.45721E+00	-.45721E+00	-.40324E+00
CLN-IND =	-.67146E-12	-.30202E+00	-.58440E+00	-.58440E+00	.30202E+00	-.61640E-12

NOTE: L.E. OF LEAD PANEL IN FIRST CHORDWISE ROW IS SUPERSONIC

-----RIGHT WING-----

SPACWISE DISTRIBUTIONS

I	V/(R/2)	CH/C/(2+R)	CT/C/(2+R)	CY1/C/(2+R)	CYINT/C/(2+R)	CS/C/(2+R)	CSINT	VBAR	GAMMA(1)	GAMMA,LE/VINF	XLE
1	.65426	.18934	0.00000	0.00000	.00040	0.00000	0.00000	0.00000	-.88666	0.00000	.13334
2	.84415	.18692	0.00000	0.00000	.00266	0.00000	0.00000	0.00000	.01136	0.00000	.40340
3	1.05402	.17349	0.00000	0.00000	.00215	0.00000	0.00000	0.00000	.06091	0.00000	.67342
4	1.25346	.14774	0.00000	0.00000	.00205	0.00000	0.00000	0.00000	.12550	0.00000	.94341
5	1.45367	.10535	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.20592	0.00000	1.21335
6	1.55554	0.00000							.48293		

SUMFX = 0.  
 SUMFY1 = 0.  
 SUMFY2 = .50439E-02  
 SUMFT2 = .27045E+01

Figure 6.- Continued.



## SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(0.1TIPCHORD)	GAMMA,SE /VINF	YBAR	XSE
1	1	.33333	.00307	.00054	3.64000	1.35100
2	2	.66667	.03561	.00696	3.64000	2.10067
3	3	1.00000	.04649	.01511	3.64000	2.85033

\*\*\*\*P. FIN VORTEX INFO\*\*\*\*

IVRT GAMMA/VINF Y.C.G.

1 .88621 3.27795

----- LEFT WING-----

## SPANWISE DISTRIBUTIONS

I	Y/(H/2)	CW/C/(2*B)	CT/C/(2*B)	CV1/C/(2*B)	CVTOT/C/(2*B)	CS/C/(2*B)	CSTNT	YBAR	GAMNET(I)	GAMMA,LE/VINF	XLE
7	-.65426	.18946	0.00000	0.00000	-.00040	0.00000	0.00000	0.00000	.88646	0.00000	.13334
8	-.85415	.18692	0.00000	0.00000	-.00266	0.00000	0.00000	0.00000	-.01134	0.00000	.40340
9	-1.05402	.17389	0.00000	0.00000	-.00215	0.00000	0.00000	0.00000	-.06091	0.00000	.67342
10	-1.25386	.14706	0.00000	0.00000	-.00205	0.00000	0.00000	0.00000	-.12554	0.00000	.94341
11	-1.45367	.10308	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.20592	0.00000	1.21335
12	-1.65554	0.00000							-.48293		

SUMFX = 0.  
 SUMFY1 = 0.  
 SUMFY2 = -.59819E+02  
 SUMFT2 = -.27045E+01

## SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(0.1TIPCHORD)	GAMMA,RE /VINF	YBAR	XSE
1	1	.33333	.00307	.00054	3.64000	1.35100
2	2	.66667	.03561	.00696	3.64000	2.10067
3	3	1.00000	.04649	.01511	3.64000	2.85033

Figure 6.- Continued.

\*\*\*\*\*E. FIN VORTEX INFO\*\*\*\*\*

INVT GAMMA/VINF Y.C.G.

2 .AR621 3.27795

-----UPPER WING-----

# SPANWISE DISTRIBUTIONS

I	Z/(B/2)	C <sub>Y</sub> *C/(2*B)	C <sub>L</sub> *C/(2*B)	C <sub>Z1</sub> *C/(2*B)	C <sub>ZTOT</sub> *C/(2*B)	C <sub>S</sub> *C/(2*B)	CSINT	ZBAR	GAMMA(1)	GAMMA,LF/VINF	XLF
13	.65426	.18936	0.00000	0.00000	.00000	0.00000	0.00000	0.00000	.AR621	0.00000	.13334
14	.85415	.18692	0.00000	0.00000	.00220	0.00000	0.00000	0.00000	.01136	0.00000	.40340
15	1.05402	.17389	0.00000	0.00000	.00215	0.00000	0.00000	0.00000	.06091	0.00000	.67347
16	1.25396	.14706	0.00000	0.00000	.00205	0.00000	0.00000	0.00000	.12554	0.00000	.94341
17	1.45367	.10309	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.20592	0.00000	1.21335
18	1.55556	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.49293		

SUMFY = 0.  
 SUMFZ1 = 0.  
 SUMFZ2 = .59839E-02  
 SUMFT2 = .27045E-01

# SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(0.1TIPCHORD)	GAMMA,SE /VINF	ZBAR	XSE
1	4	.33333	.00307	.00054	3.64000	1.35100
2	5	.66667	.03561	.00696	3.64000	2.10067
3	6	1.00000	.00649	.01511	3.64000	2.95033

\*\*\*\*\*E. FIN VORTEX INFO\*\*\*\*\*

INVT GAMMA/VINF Z.C.G.

3 .AR621 3.27795

Figure 6.- Continued.

-----L0\*ER =ING-----

## SPANWISE DISTRIBUTIONS

I	Z/(R/2)	CN*C/(2*H)	CT*C/(2*H)	CZ1*C/(2*H)	CZTOT*C/(2*H)	CS*C/(2*H)	CSINT	ZBAR	GAMNET(I)	GAMMA,LE/VINF	XLE
19	-.65426	.18936	0.00000	0.00000	-.00040	0.00000	0.00000	0.00000	.88666	0.00000	.13334
20	-.85415	.18642	0.00000	0.00000	-.00246	0.00000	0.00000	0.00000	-.01136	0.00000	.46340
21	-1.05402	.17349	0.00000	0.00000	-.00215	0.00000	0.00000	0.00000	-.06091	0.00000	.67342
22	-1.25386	.14706	0.00000	0.00000	-.00205	0.00000	0.00000	0.00000	-.12554	0.00000	.94341
23	-1.45367	.10408	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.20592	0.00000	1.21335
24	-1.55556	0.00000							-.48293		

SUMFY = 0.  
 SUMFZ1 = 0.  
 SUMFZ2 = -.59839E+02  
 SUMFT2 = -.27045E+01

## SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SECTION FORCE PER UNIT LENGTH /(Q*TIPCHORD)	GAMMA,SE /VINF	ZBAR	XRE
1	7	.43343	-.00307	-.00054	-3.64000	1.35100
2	8	.66667	-.00356	-.00686	-3.64000	2.10067
3	9	1.00000	-.04649	-.01511	-3.64000	2.85033

\*\*\*\*E. FIN VORTEX INFO\*\*\*\*

IVRT GAMMA/VINF Z.C.G.

4 -.88621 -3.27795

## VELOCITIES AND BERNOLLI PRESSURES AT CONTINUUM POINTS IMMEDIATELY ABOVE AND BELOW HORIZONTAL WING SURFACE

J	X(J)	Y(J)	Z(J)	UTOT	VTOT	WTOT	PRESSA	UTOTB	VTOTB	WTOTB	PRESSB
1	1.231118	1.530959	0.000000	.150107	.0009157	-.173650	-.232106	-.186636	.185261	-.173650	.507944
2	2.386670	1.530959	0.000000	.129322	.070070	-.173650	-.185694	-.119079	.185680	-.173650	.336862
3	3.542222	1.530959	0.000000	.113465	.148769	-.173650	-.167160	-.068697	.203827	-.032650	.189374
4	4.697774	1.998701	0.000000	.251532	-.137014	-.173650	-.178470	-.111513	.072591	-.173650	.303894
5	5.853326	1.998701	0.000000	.130365	.023599	-.173650	-.195638	-.130793	.124119	-.173650	.362347

Figure 6.- Continued.

4	3.546723	1.994701	0.000000	1.64735	1.24139	-0.314650	-0.218475	-0.051527	1.58102	-0.032650	1.51421
7	1.600170	2.466397	0.000000	1.76868	-0.039452	-0.173650	-0.275450	-0.179328	1.66197	-0.173650	1.489158
8	2.575697	2.466397	0.000000	1.67531	-0.001452	-0.173650	-0.254622	-0.118118	1.08495	-0.173650	1.378461
9	3.551224	2.466397	0.000000	2.57271	0.084465	-0.114650	-0.337191	0.042207	1.25403	-0.032650	1.047964
10	1.784662	2.934030	0.000000	1.844450	-0.317110	-0.173650	-0.278223	-0.154402	1.44180	-0.173650	1.436543
11	2.671193	2.934030	0.000000	1.94586	-0.055027	-0.173650	-0.305471	-0.061451	0.54054	-0.173650	1.274995
12	1.555723	2.934030	0.000000	1.17778	0.294044	-0.114650	-0.184044	-0.040092	0.590946	-0.032650	1.02417
13	1.969121	3.401580	0.000000	1.26247	0.02307	-0.173650	-0.185437	-0.173276	2.15217	-0.173650	1.470855
14	2.760472	3.401580	0.000000	0.41750	0.014390	-0.173650	-0.134517	-0.099502	0.02003	-0.173650	1.279024
15	3.546222	3.401580	0.000000	2.12412	-0.063427	-0.173650	-0.333055	-0.06662	0.00951	-0.032650	1.174457
16	1.231118	-1.530959	0.000000	1.52074	0.265202	-0.173650	-0.214753	-0.184670	0.70784	-0.173650	1.485707
17	2.386670	-1.530959	0.000000	1.22888	1.76868	-0.173650	-0.167575	-0.125543	0.01251	-0.173650	1.340432
18	3.542222	-1.530959	0.000000	2.28762	1.62443	-0.314650	-0.324682	0.046600	1.27406	-0.032650	1.052137
19	1.415654	-1.994701	0.000000	2.54058	2.88984	-0.173650	-0.348754	-0.184947	0.79299	-0.173650	1.299437
20	2.481188	-1.994701	0.000000	1.46320	1.46320	-0.173650	-0.205014	-0.114838	0.45543	-0.173650	1.303185
21	3.546723	-1.994701	0.000000	2.14443	1.25737	-0.114650	-0.316291	0.01221	0.67774	-0.032650	1.046884
22	1.600170	-2.466397	0.000000	1.74004	1.15310	-0.173650	-0.248710	-0.140142	0.70339	-0.173650	1.597340
23	2.575697	-2.466397	0.000000	1.70160	1.02179	-0.173650	-0.242750	-0.115489	0.07767	-0.173650	1.281734
24	3.551224	-2.466397	0.000000	2.42287	0.15453	-0.314650	-0.349947	0.049313	-0.021465	-0.032650	1.089321
25	1.784662	-2.934030	0.000000	1.79484	0.98715	-0.173650	-0.09717	-0.159807	0.07175	-0.173650	1.324357
26	2.670193	-2.934030	0.000000	2.01080	1.27184	-0.173650	-0.282531	-0.083658	0.17789	-0.173650	1.219104
27	3.555723	-2.934030	0.000000	1.12134	0.54871	-0.114650	-0.205623	-0.021734	0.29459	-0.032650	0.849339
28	1.969121	-3.401580	0.000000	1.25080	0.06754	-0.173650	-0.191249	-0.174443	1.166173	-0.173650	1.62121
29	2.760472	-3.401580	0.000000	0.99902	0.61085	-0.173650	-0.130050	-0.100350	0.042528	-0.173650	1.228046
30	3.560222	-3.401580	0.000000	2.15752	1.14020	-0.314650	-0.311254	0.094483	0.095648	-0.032650	1.148916

VELOCITIES AND MERIDIONAL PRESSURES AT CONTROL POINTS IMMEDIATELY TO RIGHT AND LEFT OF VERTICAL AING SURFACE

J	X(J)	Y(J)	Z(J)	UTOT	VTOT	WTOT	PRESS	UTOT	VTOT	WTOT	PRESS
31	1.231118	0.000000	1.530959	-0.144670	1.73650	-0.070784	0.485707	1.42073	1.73650	-0.265202	0.218753
32	2.386670	0.000000	1.530959	-0.125543	1.73650	-0.081251	0.340432	1.27868	1.73650	-0.178680	0.167575
33	3.542222	0.000000	1.530959	0.046600	0.314650	-0.127406	-0.052137	2.28762	0.032650	-0.162443	0.324882
34	1.415654	0.000000	1.994701	-0.108987	1.73650	-0.079299	0.294537	2.54058	1.73650	-0.288901	0.348754
35	2.481188	0.000000	1.994701	-0.114434	1.73650	-0.045543	0.303185	1.46320	1.73650	-0.144663	0.205016
36	3.546723	0.000000	1.994701	0.01221	0.314650	-0.087774	0.046844	2.38443	0.032650	-0.125737	0.336291
37	1.600170	0.000000	2.466397	-0.180142	1.73650	0.070339	0.397384	1.76014	1.73650	-0.135410	0.208710
38	2.575697	0.000000	2.466397	-0.115489	1.73650	0.07767	0.281734	1.70160	1.73650	-0.102179	0.292750
39	3.551224	0.000000	2.466397	0.049313	0.314650	0.021645	-0.049321	2.02287	0.032650	-0.015453	0.349987
40	1.784662	0.000000	2.934030	-0.152807	1.73650	0.097175	0.328657	1.79484	1.73650	-0.098715	0.255977
41	2.670193	0.000000	2.934030	-0.083658	1.73650	-0.017789	0.219104	2.01080	1.73650	-0.127345	0.255977
42	3.555723	0.000000	2.934030	-0.021734	0.314650	-0.029059	0.064939	1.12134	0.032650	-0.058671	0.205823
43	1.969121	0.000000	3.401580	-0.174403	1.73650	0.166173	0.302127	1.25080	1.73650	-0.208756	0.191249
44	2.760472	0.000000	3.401580	-0.100350	1.73650	0.042528	0.040902	1.73650	1.73650	-0.310245	0.136050
45	3.560222	0.000000	3.401580	0.094483	0.314650	-0.095648	0.148916	2.15752	0.032650	-0.114024	0.311254
46	1.231118	0.000000	-1.530959	-0.144670	1.73650	-0.185261	0.507940	1.40107	1.73650	-0.009157	0.232106
47	2.386670	0.000000	-1.530959	-0.114079	1.73650	-0.165680	0.336822	1.24322	1.73650	-0.070070	0.185698
48	3.542222	0.000000	-1.530959	-0.06662	0.114650	-0.203827	1.89374	1.13445	0.032650	-0.168749	0.167160
49	1.415654	0.000000	-1.994701	-0.11513	1.73650	-0.072541	0.303890	2.51532	1.73650	-0.137014	0.376070
50	2.481188	0.000000	-1.994701	-0.130793	1.73650	-0.124119	0.362347	1.30365	1.73650	-0.023409	0.195634
51	3.546723	0.000000	-1.994701	-0.01527	0.314650	-0.151102	0.145735	2.12650	0.032650	-0.120139	0.216875
52	1.600170	0.000000	-2.466397	-0.179328	1.73650	-0.166197	0.489158	1.76868	1.73650	-0.039052	0.275050
53	2.575697	0.000000	-2.466397	-0.118118	1.73650	-0.108495	0.267531	1.67531	1.73650	-0.01452	0.250422
54	3.551224	0.000000	-2.466397	0.042207	0.314650	-0.125603	-0.067964	2.17271	0.032650	-0.064465	0.317191
55	1.784662	0.000000	-2.934030	-0.154402	1.73650	-0.164180	0.436543	1.80440	1.73650	-0.31710	0.276223
56	2.670193	0.000000	-2.934030	-0.084151	1.73650	-0.054054	0.217995	1.98586	1.73650	-0.055542	0.305871
57	3.555723	0.000000	-2.934030	-0.034002	0.314650	-0.059096	0.102817	1.17778	0.032650	-0.029484	0.180040

Figure 6.- Continued.

5A	1.969121	0.000000	-3.401580	-.173276	.173650	-.215237	.470854	.126247	.173650	-.042307	-.185537
59	2.764672	0.000000	-3.401580	-.099502	.173650	-.092003	.279428	.091750	.173650	-.014490	-.136517
60	3.560222	0.000000	-3.401580	.096602	.314450	.040951	-.174457	.212912	.032650	.063327	-.333055

## PRESSURE LOADINGS AT CONTROL POINTS

J	X(J)	Y(J)	Z(J)	DELTP,LIN.	DELTP,HEMN.
1	1.231118	1.530959	0.000000	.673486	.740049
2	2.386670	1.530959	0.000000	.496803	.522560
3	3.542222	1.530959	0.000000	.364325	.356534
4	1.415654	1.998701	0.000000	.726090	.682364
5	2.481188	1.998701	0.000000	.522316	.557945
6	3.546723	1.998701	0.000000	.394522	.370496
7	1.600170	2.466397	0.000000	.712392	.764408
8	2.575497	2.466397	0.000000	.571298	.543081
9	3.551224	2.466397	0.000000	.385949	.289228
10	1.784662	2.934030	0.000000	.678583	.714766
11	2.670193	2.934030	0.000000	.569475	.543464
12	3.555723	2.934030	0.000000	.307739	.291860
13	1.969121	3.401580	0.000000	.599046	.656192
14	2.764672	3.401580	0.000000	.382503	.414445
15	3.560222	3.401580	0.000000	.232539	.158598
16	1.231118	-1.530959	0.000000	.673486	.704460
17	2.386670	-1.530959	0.000000	.496803	.508007
18	3.542222	-1.530959	0.000000	.364325	.272545
19	1.415654	-1.998701	0.000000	.726090	.648391
20	2.481188	-1.998701	0.000000	.522316	.508200
21	3.546723	-1.998701	0.000000	.394522	.289407
22	1.600170	-2.466397	0.000000	.712392	.646089
23	2.575497	-2.466397	0.000000	.571298	.524487
24	3.551224	-2.466397	0.000000	.385949	.260685
25	1.784662	-2.934030	0.000000	.678583	.584635
26	2.670193	-2.934030	0.000000	.569475	.501635
27	3.555723	-2.934030	0.000000	.307739	.269561
28	1.969121	-3.401580	0.000000	.599046	.493376
29	2.764672	-3.401580	0.000000	.382503	.358096
30	3.560222	-3.401580	0.000000	.232539	.162342
31	1.231118	0.000000	1.530959	.673486	.704460
32	2.386670	0.000000	1.530959	.496803	.508007
33	3.542222	0.000000	1.530959	.364325	.272545
34	1.415654	0.000000	1.998701	.726090	.648391
35	2.481188	0.000000	1.998701	.522316	.508200
36	3.546723	0.000000	1.998701	.394522	.289407
37	1.600170	0.000000	2.466397	.712392	.646089
38	2.575497	0.000000	2.466397	.571298	.524487
39	3.551224	0.000000	2.466397	.385949	.260685
40	1.784662	0.000000	2.934030	.678583	.584635
41	2.670193	0.000000	2.934030	.569475	.501635
42	3.555723	0.000000	2.934030	.307739	.269561
43	1.969121	0.000000	3.401580	.599046	.493376
44	2.764672	0.000000	3.401580	.382503	.358096
45	3.560222	0.000000	3.401580	.232539	.162342
46	1.231118	0.000000	-1.530959	.673486	.740049
47	2.386670	0.000000	-1.530959	.496803	.522560
48	3.542222	0.000000	-1.530959	.364325	.356534
49	1.415654	0.000000	-1.998701	.726090	.682364

Figure 6.- Continued.

50	2.481188	0.000000	-1.998701	.522318	.557985
51	3.546725	0.000000	-1.998701	.504522	.370498
52	1.600170	0.000000	-2.466397	.712392	.764608
53	2.575697	0.000000	-2.466397	.571298	.581083
54	3.551224	0.000000	-2.466397	.485909	.289228
55	1.784662	0.000000	-2.934030	.678583	.714766
56	2.870193	0.000000	-2.934030	.589475	.543966
57	3.555723	0.000000	-2.934030	.507739	.291860
58	1.969121	0.000000	-3.401580	.599046	.656192
59	2.764672	0.000000	-3.401580	.382503	.614485
60	3.560222	0.000000	-3.401580	.232539	.158598

# LOADING INFORMATION

MACH NUMBER = .17000E+01  
 ANGLE OF ATTACK = 10.000 DEGREES  
 SIDE SLIP ANGLE = 10.000 DEGREES  
 WING AREA = 13.88888  
 REFERENCE AREA = 5.30920  
 REFERENCE LENGTH = 2.59000  
 EXPOSED WING SPAN B = 9.68000  
 MOMENT CENTER XM = 19.50000  
 ZM = 0.00000

## BERNOULLI TYPE LOADING PRESSURE

REF. ANGLE DEG.	TOTAL	FIN 1 OR R	FIN 2 OR L	FIN 3 OR U	FIN 4 OR D	INTERF. SHELL
CTH0 =	.61347E+01	.16075E+01	.14598E+01	.14598E+01	.16075E+01	
CZ =	.15087E+01	.66375E+00	.58666E+00	0.	0.	.25832E+00
CY =	-.15087E+01	0.	0.	-.58666E+00	-.66375E+00	-.25832E+00
CM =	-.14851E+01	-.43842E+00	-.56128E+00	0.	0.	-.28518E+00
CLN =	.14851E+01	0.	0.	.56128E+00	.63867E+00	.28518E+00
CLI =	.60190E+13	-.57593E+00	.50480E+00	-.50480E+00	.57593E+00	.24098E+15

## FOLLOWING ARE IN WIND-AXIS SYSTEM

CL =	.20840E+01	.45892E+00	.40571E+00	.40571E+00	.45892E+00	.35414E+00
CY-IND =	.72267E+12	.46934E+00	.41483E+00	-.41483E+00	-.46934E+00	.72387E+12
COT =	.46452E+00	.99677E+01	.87723E+01	.87723E+01	.99677E+01	.89715E+01
COT/CL*2 =	.10702E+00					
CM-IND =	-.21002E+01	-.45157E+00	-.39688E+00	-.39688E+00	-.45157E+00	-.40328E+00
CLN-IND =	-.65725E+12	-.29631E+00	-.50870E+00	.50870E+00	.29631E+00	-.61640E+12

NOTE: L.F. OF LEAD PANEL IN FIRST CHORDWISE QU. IS SUPERSONIC

Figure 6.- Continued.

-----RIGHT WING-----

## SPARWISE DISTRIBUTIONS

I	Y/(H/2)	CN=C/(2*B)	CT=C/(2*B)	CY1=C/(2*B)	CYTOT=C/(2*B)	CS=C/(2*B)	CSINT	YBAR	GAMNET(I)	GAMMA <sub>RE</sub> /VINF	XLE
1	.65426	.19979	0.00000	0.00000	.00425	0.00000	0.00000	0.00000	-.93550	0.00000	.13334
2	.85415	.18427	0.00000	0.00000	.00106	0.00000	0.00000	0.00000	.07730	0.00000	.40340
3	1.05402	.17008	0.00000	0.00000	.00208	0.00000	0.00000	0.00000	.05478	0.00000	.67342
4	1.25386	.14656	0.00000	0.00000	.00203	0.00000	0.00000	0.00000	.11192	0.00000	.94341
5	1.45367	.10438	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.19747	0.00000	1.21335
6	1.55556	0.09000							.48904		

SUMFX = 0.  
 SUMFY1 = 0.  
 SUMFY2 = .69502E+02  
 SUMFY2 = .28353E+01

## SIDE EDGE DISTRIBUTION

JTIP	JSF	DISTANCE FROM LE /TIPCHORD	SECTION FORCE PER UNIT LENGTH /(R*TIPCHORD)	GAMMA <sub>RE</sub> /VINF	YBAR	XSE
1	1	.33333	.00337	.00060	3.60000	1.45100
2	2	.66667	.03885	.00749	3.60000	2.10067
3	3	1.00000	.04707	.01944	3.60000	2.85031

\*\*\*T.E. FTH VORTEX INFIL\*\*\*

IVRT GAMMA/VINF Y.C.G.

1 .93503 3.18446

----- LEFT WING-----

SPARSE DISTRIBUTIONS

I	Y/(H/2)	C0=C/(2*B)	C1=C/(2*B)	CY1=C/(2*B)	CYTOT=C/(2*B)	CS=C/(2*B)	CSINT	YBAR	GAMNET(I)	GAMMA,LF/VINF	YLL
7	-.85426	.18324	0.00000	0.00000	-.00362	0.00000	0.00000	0.00000	.85800	0.00000	.13314
8	-.85415	.16451	0.00000	0.00000	-.00281	0.00000	0.00000	0.00000	-.08752	0.00000	.40340
9	-1.05402	.14906	0.00000	0.00000	-.00182	0.00000	0.00000	0.00000	-.07227	0.00000	.67342
10	-1.25385	.12816	0.00000	0.00000	-.00197	0.00000	0.00000	0.00000	-.09779	0.00000	.94341
11	-1.45367	.08608	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.19706	0.00000	1.21335
12	-1.55556	0.00000							-.40327		

SUMFY = 0.0000  
 SUMFY1 = 0.0000  
 SUMFY2 = -.84305E-02  
 SUMFT2 = -.22939E-01

SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SECTION FORCE PER UNIT LENGTH (/TIPCHORD)	GAMMA,SE /VINF	YBAR	XSE
1	1	.34433	-.00253	0.00045	-3.64000	1.45100
2	2	.65667	-.03089	-.00593	-3.64000	2.10067
3	3	1.00000	-.03582	-.01281	-3.64000	2.85033

\*\*\*\*T.F. FIN VORTEX INFO\*\*\*\*

IVRT GAMMA/VINF Y.C.G.

2 -.85757 -3.11600

Figure 6.- Continued.



-----UPPER WING-----

## SPANWISE DISTRIBUTIONS

I	Z/(H/2)	CN=C/(2*B)	CT=C/(2*B)	CZ1=C/(2*B)	CZTOT=C/(2*B)	CS=C/(2*B)	CSINT	ZBAR	GAMNET(I)	GAMMA,LE/VINF	XLE
13	.65426	.18324	0.00000	0.00000	.00362	0.00000	0.00000	0.00000	-.85800	0.00000	.13334
14	.85415	.16451	0.00000	0.00000	.00281	0.00000	0.00000	0.00000	.08762	0.00000	.40340
15	1.05402	.14906	0.00000	0.00000	.00182	0.00000	0.00000	0.00000	.07227	0.00000	.67342
16	1.25386	.12816	0.00000	0.00000	.00197	0.00000	0.00000	0.00000	.09779	0.00000	.94341
17	1.45367	.08638	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.19704	0.00000	1.21335
18	1.54556	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.40327	0.00000	

SUMEX = 0.  
 SUMEZ1 = 0.  
 SUMEZ2 = .84305E+02  
 SUMET2 = .22939E+01.

## SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(0.5TIPCHORD)	GAMMA,SE /VINF	ZBAR	XSE
1	4	.33333	.00253	.00045	3.64000	1.35100
2	5	.66667	.03089	.00593	3.64000	2.10067
3	6	1.00000	.03882	.01281	3.64000	2.85033

\*\*\*\*\*E. FIN VORTEX INFO\*\*\*\*\*

IVRT GAMMA/VINF Z.C.G.  
 3 .85757 3.11604

Figure 6.- Continued.

----- G-PR -ING-----

# SPANWISE DISTRIBUTIONS

I	Z/(B/2)	C4*C/(2*B)	C1*C/(2*B)	CZ1*C/(2*B)	CZTOT*C/(2*B)	C5*C/(2*B)	CSINT	ZBAR	GAMNET(I)	GAMMA,LF/VINF	XIE
19	-.65426	.19979	0.00000	0.00000	-.00325	0.00000	0.00000	0.00000	.93556	0.00000	.13334
20	-.85415	.18327	0.00000	0.00000	-.00106	0.00000	0.00000	0.00000	-.07730	0.00000	.40340
21	-1.05402	.17044	0.00000	0.00000	-.00208	0.00000	0.00000	0.00000	-.05478	0.00000	.67342
22	-1.25386	.14656	0.00000	0.00000	-.00203	0.00000	0.00000	0.00000	-.11192	0.00000	.94341
23	-1.45367	.10438	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.19747	0.00000	1.21335
24	-1.55456	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.48904		

SUMFX = 0.  
 SUMFZ1 = 0.  
 SUMFZ2 = -.69542E-02  
 SUMFZ2 = -.28353E-01

# SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(4*TIPCHORD)	GAMMA,SP /VINF	ZBAR	XSE
1	7	.33333	-.00337	-.00060	-3.64000	1.35100
2	8	.66667	-.03885	-.00749	-3.64000	2.10067
3	9	1.00000	-.04707	-.01584	-3.64000	2.85033

\*\*\*\*T.E. FIN VORTEX INFO\*\*\*\*

IVRT GAMMA/VINF Z,C.G.

4 -.03503 -5.18446

\*\*\*\*\*  
 AFT OF LEADING EDGE OF FIN BUTCHORDS

Figure 6.- Continued.

## PRESSURE COEFFICIENTS AT POINTS ON BODY MERIDIANS

J	THETA, DEG.	XH	YH	ZH	U10T	V10T	W10T	CP, LIN.	CP, REYN.	QR/UY	P/PI-IF, BFNN.	P/PI-IF, LIN.
BODY RING# 1												
1	11.25000	20.94000	1.25052	.24874	.11130	.12273	.11776	-.22260	-.21167	0.00000	.57179	.54968
2	33.75000	20.94000	1.06014	.70836	.02622	-.09448	.23203	-.05244	-.19266	0.00000	.61026	.89390
3	56.25000	20.94000	.70836	1.06014	-.05100	-.19760	.07152	.10199	-.04014	0.00000	.91880	1.20633
4	78.75000	20.94000	.24874	1.25052	-.12330	-.10673	-.12489	.24661	.23477	0.00000	1.47494	1.49488
5	101.25000	20.94000	-.24874	1.25052	.11085	.02473	-.21377	-.22171	-.14584	0.00000	.66451	.55149
6	123.75000	20.94000	-.70836	1.06014	.02416	.11698	-.22613	-.04632	.00696	0.00000	1.01407	.90226
7	146.25000	20.94000	-1.06014	.70836	.02416	.22613	-.11698	-.04632	.00696	0.00000	1.01407	.90226
8	168.75000	20.94000	-1.25052	.24874	.11085	.21377	-.02473	-.14584	0.00000	0.00000	.66451	.55149
9	191.25000	20.94000	-1.25052	-.24874	-.12330	.12489	.10673	.24661	.23477	0.00000	1.47494	1.49488
10	213.75000	20.94000	-1.06014	-.70836	-.05100	-.07152	.19760	.10199	-.04014	0.00000	.91880	1.20633
11	236.25000	20.94000	-.70836	-1.06014	.02622	-.09448	-.23203	-.05244	-.19266	0.00000	.61026	.89390
12	258.75000	20.94000	-.24874	-1.25052	.11130	-.11776	-.12273	-.22260	-.21167	0.00000	.57179	.54968
13	281.25000	20.94000	.24874	-1.25052	-.12286	.03577	-.21161	.24571	.31677	0.00000	1.64083	1.49707
14	303.75000	20.94000	.70836	-1.06014	-.04893	.15140	-.20317	.09787	.16871	0.00000	1.34131	1.19798
15	326.25000	20.94000	1.06014	-.70836	-.04893	.20317	-.15140	.09787	.16871	0.00000	1.34131	1.19798
16	348.75000	20.94000	1.25052	-.24874	-.12286	.21161	-.03577	.24571	.31677	0.00000	1.64083	1.49707
BODY RING# 2												
1	11.25000	22.14000	1.25052	.24874	.11021	.12916	.08542	-.20841	-.18841	0.00000	.61884	.57838
2	33.75000	22.14000	1.06014	.70836	.01537	-.02324	.12539	-.03074	-.09119	0.00000	.61552	.93781
3	56.25000	22.14000	.70836	1.06014	-.07275	-.09832	.00518	.14551	.09614	0.00000	1.19449	1.29436
4	78.75000	22.14000	.24874	1.25052	-.11800	-.02813	-.12859	.23600	.23666	0.00000	1.47874	1.47742
5	101.25000	22.14000	-.24874	1.25052	.11874	.02657	-.21341	-.23708	-.17802	0.00000	.63987	.51958
6	123.75000	22.14000	-.70836	1.06014	.10747	.12241	-.22251	-.21494	-.14596	0.00000	.70473	.56517
7	146.25000	22.14000	-1.06014	.70836	.10747	.22251	-.12241	-.21494	-.14596	0.00000	.70473	.56517
8	168.75000	22.14000	-1.25052	.24874	.11874	.21341	-.02657	-.21748	-.17802	0.00000	.63987	.51958
9	191.25000	22.14000	-1.25052	-.24874	-.11800	.12859	.02813	.23600	.23666	0.00000	1.47874	1.47742
10	213.75000	22.14000	-1.06014	-.70836	-.07275	-.04518	.09832	.14551	.09614	0.00000	1.19449	1.29436
11	236.25000	22.14000	-.70836	-1.06014	.01537	-.12539	.02324	-.03074	-.09119	0.00000	.61552	.93781
12	258.75000	22.14000	-.24874	-1.25052	.11021	-.08542	-.12916	-.20841	-.18841	0.00000	.61884	.57838
13	281.25000	22.14000	.24874	-1.25052	-.13253	.02387	-.21397	.26506	.33497	0.00000	1.67745	1.53622
14	303.75000	22.14000	.70836	-1.06014	-.14485	.14948	-.20445	.32971	.44960	0.00000	1.90954	1.66699
15	326.25000	22.14000	1.06014	-.70836	-.14485	.20445	-.14948	.32971	.44960	0.00000	1.90954	1.66699
16	348.75000	22.14000	1.25052	-.24874	-.13253	.21397	-.02387	.26506	.33497	0.00000	1.67745	1.53622
BODY RING# 3												
1	11.25000	23.34000	1.25052	.24874	.07229	.14316	.01498	-.14459	-.11128	0.00000	.77484	.70750
2	33.75000	23.34000	1.06014	.70836	.00171	.00402	.07860	-.00142	-.03324	0.00000	.93275	.99407
3	56.25000	23.34000	.70836	1.06014	-.01831	-.08234	-.00548	.03662	.00163	0.00000	1.00331	1.07408
4	78.75000	23.34000	.24874	1.25052	-.00643	-.13334	.01285	-.02404	0.00000	0.00000	.95137	1.02601
5	101.25000	23.34000	-.24874	1.25052	.17952	.06566	-.20564	-.35404	-.26020	0.00000	.47362	.27367
6	123.75000	23.34000	-.70836	1.06014	.15449	.12491	-.22084	-.30897	-.21983	0.00000	.55528	.37495
7	146.25000	23.34000	-1.06014	.70836	.15449	.22084	-.12491	-.30897	-.21983	0.00000	.55528	.37495
8	168.75000	23.34000	-1.25052	.24874	.17952	.20564	-.06566	-.35404	-.26020	0.00000	.47362	.27367
9	191.25000	23.34000	-1.25052	-.24874	-.00643	.13334	.01285	-.02404	0.00000	0.00000	.95137	1.02601
10	213.75000	23.34000	-1.06014	-.70836	-.01831	.08234	.00548	.03662	.00163	0.00000	1.00331	1.07408

Figure 6.- Continued.

11	236,25000	23,34000	-.70836	-1.06014	.00171	-.07860	-.00802	-.00342	-.01124	0.00000	.91275	.99307
12	258,75000	23,34000	-.24874	-1.25052	.07229	-.01498	-.14316	-.10459	-.11128	0.00000	.77488	.70750
13	281,25000	23,34000	.24874	-1.25052	-.11345	-.05276	-.22421	.22730	.24834	0.00000	1.50240	1.45983
14	303,75000	23,34000	.70836	-1.06014	-.17108	.12113	-.22339	.34217	.45961	0.00000	1.92980	1.89220
15	326,25000	23,34000	1.06014	-.70836	-.17108	.22339	-.12113	.34217	.45961	0.00000	1.92980	1.89220
16	348,75000	23,34000	1.25052	-.24874	-.11345	.22921	.05276	.22730	.24834	0.00000	1.50240	1.45983

Figure 6.- Concluded.

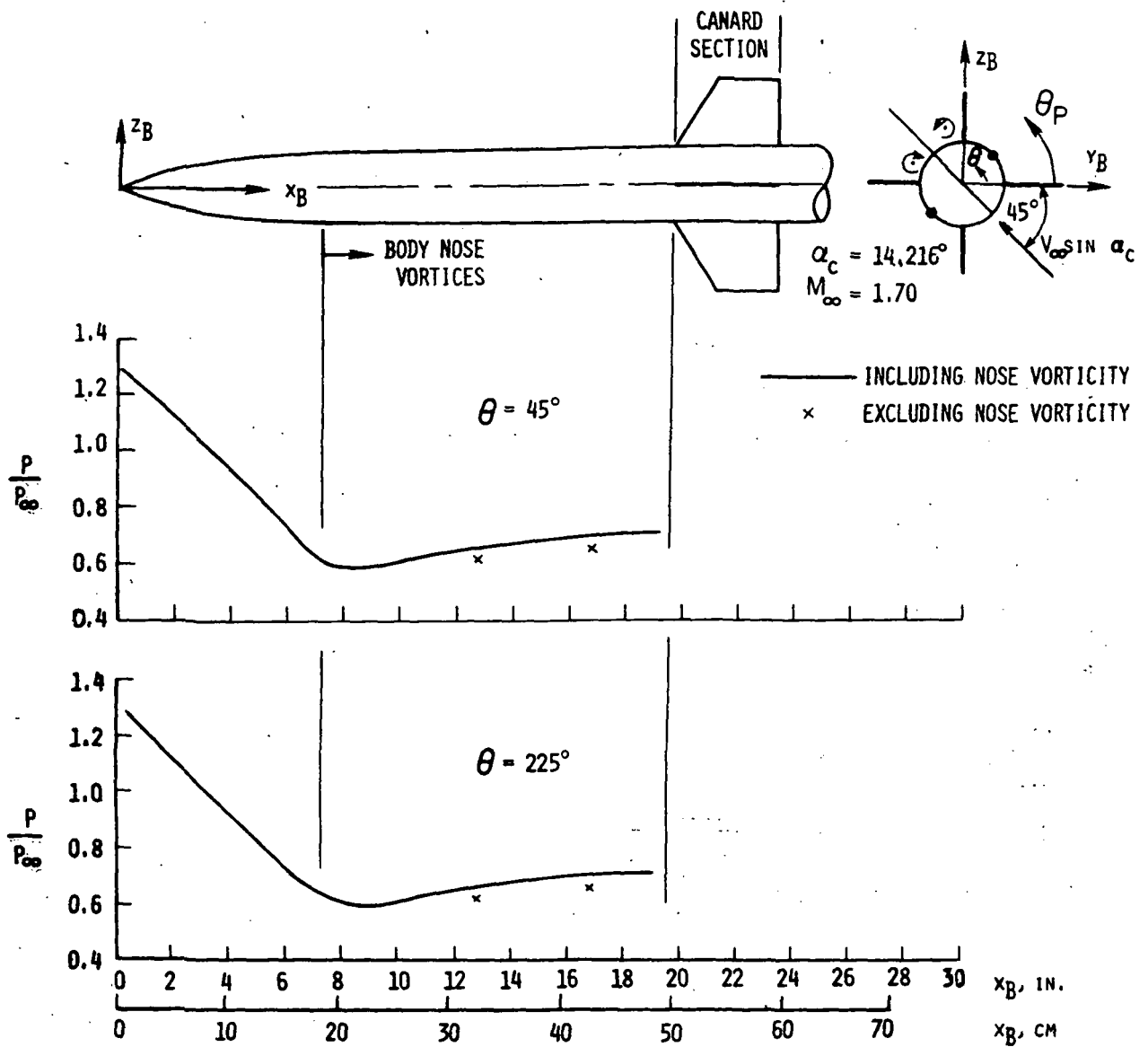


Figure 7(a).- Calculated pressure distributions along body meridians up to canard section; first sample case.

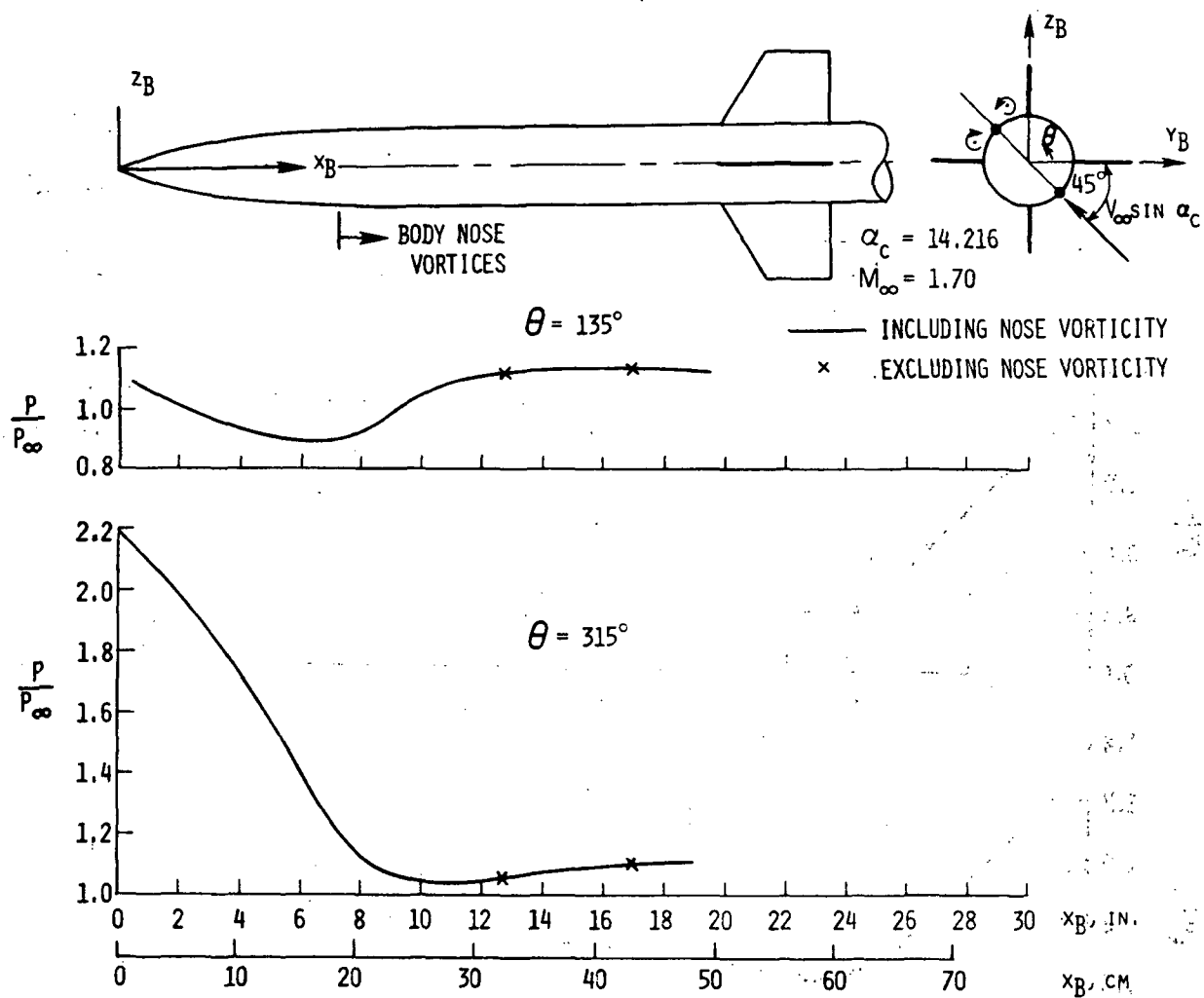


Figure 7(b).- Concluded.

NASA/LRC PROJECT 1126, CONFIGURATION B1W4, CHASE NOSE VORTICES PAST CANARD SECTION

1	4	11	1	1	0	1
23.4						
1.3						
19.8	1.3	21.151	3.64	23.4	3.64	23.400001 1.3
14.216	45.0					0.0001 0.35
2	2	2	2	2	2	
-0.64337	1.8382	0.8024	-1.8382	0.64337	-0.8024	
19.8	20.163	20.514	20.878	21.242	21.606	21.957 22.321
22.685	23.036	23.4				
0	0	0	0	0		
0						

Figure 8.- Input for program VPATH2, first sample case, step 2.

```

      FIN GEOMETRY
FIN SEMISPAN      = 3.64000
FIN ROOTCHORD    = 3.60000
FIN ROOT L.E. X-STATION= 19.80000
      L.E. Y-STATION= 1.30000
FIN TIP L.E. X-STATION = 21.15100
      L.E. Y-STATION = 3.64000
FIN TIP T.E. X-STATION = 23.40000
      T.E. Y-STATION = 3.64000
FIN ROOT T.E. X-STATION= 23.40000
      T.E. Y-STATION= 1.30000
    
```

INCLUDED ANGLE OF ATTACK(DEG) = 14.21600      ROLL ANGLE(DEG) = 45.00000

PANEL DEFL.(DEG) :

DELTA1= 0.000    DELTA2= 0.000    DELTA3= 0.000    DELTA4= 0.000

\*\*\*PERMISSIBLE RELATIVE ERROR,ES,USED IN INTEGRATION SCHEME = .10000E-03

VORTEX COORDINATES IN CROSS-FLOW PLANE

INITIAL VORTEX POSITIONS AT    X = 19.800

LOCAL BODY RADIUS = 1.30000      LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.64337E+00	.18382E+01	.40240E+00
2	-.14382E+01	.64337E+00	-.40240E+00

X-STATION NO. 2      X=20.163      INTEGRATION STEP SIZE = .18150

LOCAL BODY RADIUS = 1.30000      LOCAL SEMI SPAN S = 1.92873

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
--------	--------	--------	------------

Figure 9.- Output of program VPATH2, first sample case, step 2.



1	-.68037E+00	.18568E+01	.80240E+00
2	-.18568E+01	.68037E+00	-.80240E+00
X-STATION NO. 3 X=20.514 INTEGRATION STEP SIZE = .18150			
LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 2.53668			
VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.70316E+00	.18633E+01	.80240E+00
2	-.18633E+01	.70316E+00	-.80240E+00
X-STATION NO. 4 X=20.878 INTEGRATION STEP SIZE = .18150			
LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 3.16715			
VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.70923E+00	.18674E+01	.80240E+00
2	-.18674E+01	.70923E+00	-.80240E+00
X-STATION NO. 5 X=21.242 INTEGRATION STEP SIZE = .18150			
LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 3.64000			
VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.70610E+00	.18736E+01	.80240E+00
2	-.18736E+01	.70610E+00	-.80240E+00
X-STATION NO. 6 X=21.606 INTEGRATION STEP SIZE = .36300			
LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 3.64000			
VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.70153E+00	.18806E+01	.80240E+00
2	-.18806E+01	.70153E+00	-.80240E+00
X-STATION NO. 7 X=21.957 INTEGRATION STEP SIZE = .36300			
LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 3.64000			
VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF

Figure 9.- Continued.

1	-.69747E+00	.18977E+01	.80240E+00
2	-.18977E+01	.69747E+00	-.80240E+00

X-STATION NO. 8      X=22.321      INTEGRATION STEP SIZE =      .72600

LOCAL BODY RADIUS =      1.30000      LOCAL SEMI SPAN S =      3.64000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.69363E+00	.18953E+01	.80240E+00
2	-.18953E+01	.69363E+00	-.80240E+00

X-STATION NO. 9      X=22.685      INTEGRATION STEP SIZE =      .72600

LOCAL BODY RADIUS =      1.30000      LOCAL SEMI SPAN S =      3.64000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.69017E+00	.19031E+01	.80240E+00
2	-.19031E+01	.69017E+00	-.80240E+00

X-STATION NO. 10      X=23.036      INTEGRATION STEP SIZE =      .72600

LOCAL BODY RADIUS =      1.30000      LOCAL SEMI SPAN S =      3.64000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.68720E+00	.19109E+01	.80240E+00
2	-.19109E+01	.68720E+00	-.80240E+00

X-STATION NO. 11      X=23.400      INTEGRATION STEP SIZE =      .72600

LOCAL BODY RADIUS =      1.30000      LOCAL SEMI SPAN S =      3.64000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.68451E+00	.19192E+01	.80240E+00
2	-.19192E+01	.68451E+00	-.80240E+00

CROSSFLOW VELOCITIES AT CONTROL POINTS INDUCED BY VORTICES AND THEIR IMAGES

IC	X,BODY	Y,BODY	Z,BODY	V	W
1	.21631E+02	.15310E+01	0.	.21494E-02	-.70848E-02
2	.22187E+02	.15310E+01	0.	.22417E-02	-.73904E-02
3	.23342E+02	.15310E+01	0.	.23375E-02	-.77102E-02
4	.21218E+02	.19987E+01	0.	.40063E-02	-.44570E-02
5	.22261E+02	.19987E+01	0.	.41696E-02	-.46394E-02
6	.23347E+02	.19987E+01	0.	.43342E-02	-.48258E-02
7	.21400E+02	.24664E+01	0.	.43372E-02	-.26581E-02

Figure 9.- Continued.

8	.22376E+02	.24664E+01	0.	.44995E+02	-.27581E+02
9	.23351E+02	.24664E+01	0.	.46627E+02	-.28607E+02
10	.21585E+02	.29340E+01	0.	.41198E+02	-.14995E+02
11	.22470E+02	.29340E+01	0.	.42595E+02	-.15510E+02
12	.23356E+02	.29340E+01	0.	.44001E+02	-.16042E+02
13	.21769E+02	.34016E+01	0.	.37321E+02	-.76368E+03
14	.22565E+02	.34016E+01	0.	.34456E+02	-.78743E+03
15	.23360E+02	.34016E+01	0.	.39599E+02	-.81237E+03
16	.21031E+02	-.15310E+01	0.	-.76760E+01	-.17026E+00
17	.22187E+02	-.15310E+01	0.	-.76729E+01	-.17591E+00
18	.23342E+02	-.15310E+01	0.	-.75708E+01	-.18067E+00
19	.21216E+02	-.19987E+01	0.	-.13521E+00	-.38546E+01
20	.22291E+02	-.19987E+01	0.	-.13885E+00	-.42546E+01
21	.23347E+02	-.19987E+01	0.	-.14371E+00	-.47503E+01
22	.21400E+02	-.24664E+01	0.	-.76287E+01	.33442E+01
23	.22376E+02	-.24664E+01	0.	-.80075E+01	.34808E+01
24	.23351E+02	-.24664E+01	0.	-.84175E+01	.35781E+01
25	.21585E+02	-.29340E+01	0.	-.32972E+01	.36466E+01
26	.22470E+02	-.29340E+01	0.	-.34252E+01	.37988E+01
27	.23356E+02	-.29340E+01	0.	-.35706E+01	.39482E+01
28	.21769E+02	-.34016E+01	0.	-.14196E+01	.27926E+01
29	.22565E+02	-.34016E+01	0.	-.14621E+01	.28902E+01
30	.23360E+02	-.34016E+01	0.	-.15116E+01	.29847E+01
31	.21031E+02	.73521E+13	.15310E+01	.17026E+00	.76760E+01
32	.22187E+02	.73521E+13	.15310E+01	.17591E+00	.76729E+01
33	.23342E+02	.73521E+13	.15310E+01	.18067E+00	.75708E+01
34	.21216E+02	.95983E+13	.19987E+01	.38546E+01	.13321E+00
35	.22291E+02	.95983E+13	.19987E+01	.42546E+01	.13885E+00
36	.23347E+02	.95983E+13	.19987E+01	.47503E+01	.14371E+00
37	.21400E+02	.11844E+12	.24664E+01	-.34442E+01	.76287E+01
38	.22376E+02	.11844E+12	.24664E+01	-.34808E+01	.80075E+01
39	.23351E+02	.11844E+12	.24664E+01	-.35781E+01	.84175E+01
40	.21585E+02	.14090E+12	.29340E+01	-.36466E+01	.32972E+01
41	.22470E+02	.14090E+12	.29340E+01	-.37988E+01	.34252E+01
42	.23356E+02	.14090E+12	.29340E+01	-.39482E+01	.35706E+01
43	.21769E+02	.16335E+12	.34016E+01	-.27926E+01	.14196E+01
44	.22565E+02	.16335E+12	.34016E+01	-.28902E+01	.14621E+01
45	.23360E+02	.16335E+12	.34016E+01	-.29847E+01	.15116E+01
46	.21031E+02	-.73521E+13	-.15310E+01	.70848E+02	-.21494E+02
47	.22187E+02	-.73521E+13	-.15310E+01	.73904E+02	-.22417E+02
48	.23342E+02	-.73521E+13	-.15310E+01	.77102E+02	-.23375E+02
49	.21216E+02	-.95983E+13	-.19987E+01	.44570E+02	-.40063E+02
50	.22291E+02	-.95983E+13	-.19987E+01	.46394E+02	-.41696E+02
51	.23347E+02	-.95983E+13	-.19987E+01	.48258E+02	-.43342E+02
52	.21400E+02	-.11844E+12	-.24664E+01	.26581E+02	-.43372E+02
53	.22376E+02	-.11844E+12	-.24664E+01	.27581E+02	-.44995E+02
54	.23351E+02	-.11844E+12	-.24664E+01	.28607E+02	-.46627E+02
55	.21585E+02	-.14090E+12	-.29340E+01	.14995E+02	-.41198E+02
56	.22470E+02	-.14090E+12	-.29340E+01	.15510E+02	-.42595E+02
57	.23356E+02	-.14090E+12	-.29340E+01	.16042E+02	-.44001E+02
58	.21769E+02	-.16335E+12	-.34016E+01	.76368E+03	-.37321E+02
59	.22565E+02	-.16335E+12	-.34016E+01	.79743E+03	-.34456E+02
60	.23360E+02	-.16335E+12	-.34016E+01	.81237E+03	-.39599E+02
61	.21031E+02	.12505E+01	.24874E+00	.20095E+02	-.12229E+01
62	.22187E+02	.10601E+01	.70836E+00	.12919E+01	-.20885E+01
63	.23342E+02	.70836E+00	.10601E+01	.42643E+01	-.31116E+01
64	.21216E+02	.24874E+00	.12505E+01	.12566E+00	-.32286E+01
65	.22291E+02	-.24874E+00	.12505E+01	.32968E+00	.55337E+01
66	.23347E+02	-.70836E+00	.10601E+01	.16618E+00	.13512E+00
67	.21400E+02	-.10601E+01	.70836E+00	-.13512E+00	-.16618E+00
68	.22376E+02	-.12505E+01	.24874E+00	-.55337E+01	-.32968E+00
69	.23351E+02	-.12505E+01	-.24874E+00	.32286E+01	-.12886E+00
70	.21585E+02	-.10601E+01	-.70836E+00	.31116E+01	-.42643E+01
71	.22470E+02	-.70836E+00	-.10601E+01	.20885E+01	-.12919E+01
72	.23356E+02	-.24874E+00	-.12505E+01	.12229E+01	-.20095E+02

Figure 9.- Continued.

73	.20940E+02	.24874E+00	-.12505E+01	.58282E-02	.14082E-02
74	.20940E+02	.70836E+00	-.10601E+01	.13956E-02	.11524E-02
75	.20940E+02	.10601E+01	-.70836E+00	-.11524E-02	-.13956E-02
76	.20940E+02	.12505E+01	-.24874E+00	-.14082E-02	-.58282E-02
77	.22140E+02	.12505E+01	.24874E+00	.20985E-02	-.12770E-01
78	.22140E+02	.10601E+01	.70836E+00	.13486E-01	-.21799E-01
79	.22140E+02	.70836E+00	.10601E+01	.44448E-01	-.32424E-01
80	.22140E+02	.24874E+00	.12505E+01	.13321E+00	-.33330E-01
81	.22140E+02	-.24874E+00	.12505E+01	.32996E+00	.56340E-01
82	.22140E+02	-.70836E+00	.10601E+01	.15939E+00	.12975E+00
83	.22140E+02	-.10601E+01	.70836E+00	-.12975E+00	-.15939E+00
84	.22140E+02	-.12505E+01	.24874E+00	-.56340E-01	-.32996E+00
85	.22140E+02	-.12505E+01	-.24874E+00	.33330E-01	-.13321E+00
86	.22140E+02	-.10601E+01	-.70836E+00	.32424E-01	-.44448E-01
87	.22140E+02	-.70836E+00	-.10601E+01	.21799E-01	-.13486E-01
88	.22140E+02	-.24874E+00	-.12505E+01	.12770E-01	-.20985E-02
89	.22140E+02	.24874E+00	-.12505E+01	.60864E-02	.14706E-02
90	.22140E+02	.70836E+00	-.10601E+01	.14575E-02	.12035E-02
91	.22140E+02	.10601E+01	-.70836E+00	-.12035E-02	-.14575E-02
92	.22140E+02	.12505E+01	-.24874E+00	-.14706E-02	-.60864E-02
93	.23340E+02	.12505E+01	.24874E+00	.21926E-02	-.13340E-01
94	.23340E+02	.10601E+01	.70836E+00	.14077E-01	-.22751E-01
95	.23340E+02	.70836E+00	.10601E+01	.46275E-01	-.33741E-01
96	.23340E+02	.24874E+00	.12505E+01	.13737E+00	-.34239E-01
97	.23340E+02	-.24874E+00	.12505E+01	.32742E+00	.56877E-01
98	.23340E+02	-.70836E+00	.10601E+01	.15241E+00	.12413E+00
99	.23340E+02	-.10601E+01	.70836E+00	-.12413E+00	-.15241E+00
100	.23340E+02	-.12505E+01	.24874E+00	-.56877E-01	-.32742E+00
101	.23340E+02	-.12505E+01	-.24874E+00	.34239E-01	-.13737E+00
102	.23340E+02	-.10601E+01	-.70836E+00	.33741E-01	-.46275E-01
103	.23340E+02	-.70836E+00	-.10601E+01	.22751E-01	-.14077E-01
104	.23340E+02	-.24874E+00	-.12505E+01	.13340E-01	-.21926E-02
105	.23340E+02	.24874E+00	-.12505E+01	.63609E-02	.15369E-02
106	.23340E+02	.70836E+00	-.10601E+01	.15235E-02	.12579E-02
107	.23340E+02	.10601E+01	-.70836E+00	-.12579E-02	-.15235E-02
108	.23340E+02	.12505E+01	-.24874E+00	-.15369E-02	-.63609E-02

Figure 9.- Concluded.

NASA/LANGLEY WING-TAIL INTERFERENCE MODEL INPUT PROJ. 1124, CONFIGURATION: 8140,  
 SINGHT SREF = .550020E+01,  
 CRP = .36E+01, REFL = .269E+01,  
 S-LEP = .3E+02, PWIDTH = 0.0,  
 S-TEP = 0.0, THETIT = 0.0,  
 NCM = 3, XMLE = .199E+02,  
 NS=0 = 5, NOLINP = 1,  
 NSWL = 5, NOUT = 0,  
 ALFAC = .14216E+02, NPR = 0,  
 PH1 = .45E+02, NDRAG = 1,  
 B2 = .234E+01, NVRTY = 0,  
 FMACH = .17E+01, NPRESS = 0,  
 LVS=0 = 0, VRTMAX = .5E+00,  
 FAC = .95E+00, NCWR = 3,  
 NFVNDP = 0, NAGAIN = 0,  
 TOLFAC = .1E+01, BIL = .36E+01,  
 MSWU = 5, ITAIL = 0,  
 MSWD = 5, NVRTPL = 0,  
 S-LEV = .3E+02, NRDVPR = 1,  
 S-TEV = 0.0, NTPR = 0,  
 CRPV = .36E+01, NTDAT = 1,  
 B2V = .234E+01, NCWT = 8,  
 NCRY = 1, NCPQUT = 0,  
 RH = .13E+01, NVLIN = 1,  
 RA = .13E+01, XSTART = 0.0,  
 ERATIO = .1E+01, JCPT = 0,  
 NROCR = 16, FKLE = .5E+00,  
 DELR = 0.0, FKSE = .5E+00,  
 OFLL = 0.0, XM = .195E+02,  
 DELU = 0.0, ZM = 0.0,  
 DEID = 0.0, SEND

Figure 10.- Output of program DEMON2, first sample case, step 3.

# WING GEOMETRY

TIP CHORD = 2.24000  
 ROOT CHORD = 3.60000  
 WING SEMISPAN = 2.14000  
 LEADING EDGE SWEEP = 30.00000 DEGREES  
 TRAILING EDGE SWEEP = 0.00000 DEGREES

## FLOW CONDITIONS

MACH = 1.70000 ALPHAC = 14.21600 PMT = 45.00000 ALFA = 10.00010 BETA = 10.00010

CRPT = 3.60000  
 CRPTV = 3.60000

## WING THICKNESS INPUT DATA

SPANWISE LOCATIONS OF PANEL SIDE EDGES AND SWEEP ANGLES  
 OF WING SECTION TO THE LEFT

I	SPANWISE LOCATION FEET	LE SWEEP DEGREES	TE SWEEP DEGREES
---	------------------------------	---------------------	---------------------

## RIGHT WING SURFACE

1	1.30000	0.00000	0.00000
2	1.76800	30.00000	0.00000
3	2.23600	30.00000	0.00000
4	2.70400	30.00000	0.00000
5	3.17200	30.00000	0.00000
6	3.64000	30.00000	0.00000

40 THICKNESS PANELS ARE TO BE Laid OUT  
 4 CHORDWISE ROWS WITH 10 IN EACH ROW

## UPPER WING SURFACE

1	1.30000	0.00000	0.00000
2	1.76800	30.00000	0.00000
3	2.23600	30.00000	0.00000
4	2.70400	30.00000	0.00000
5	3.17200	30.00000	0.00000
6	3.64000	30.00000	0.00000

40 THICKNESS PANELS ARE TO BE Laid OUT  
 5 CHORDWISE ROWS WITH 8 IN EACH ROW

INPUT VALUES OF THE LOCAL SURFACE SLOPE OF THE THICKNESS  
DISTRIBUTION, FOR EACH CHORDWISE ROW THE FIRST VALUE  
IS FOR THE PANEL NEAREST THE LEADING EDGE

## RIGHT WING SURFACE

ROW	SLOPES							
1	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
2	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
3	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
4	.12200	.12200	0.00000	0.00000	0.00000	0.00000	-.14100	-.14100
5	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100

## UPPER WING SURFACE

ROW	SLOPES							
1	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
2	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
3	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
4	.12200	.12200	0.00000	0.00000	0.00000	0.00000	-.14100	-.14100
5	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100

BODY

VRTXDY = 39.

LNOSE = .78F+01.

LRODY = .39F+02.

BCODE = 2.

SEND

PHYSICAL DIMENSIONS OF BODY AND LINE SINGULARITY STRENGTHS REPRESENTING THE BODY AT MACH= 1.7000 ALFAC= 14.2140

	X	R	OR/DX	TX	T(I)	TC(I)
1	0.0000	-.42633E-13	.34286	.58610E-13	.10092	.39464E-01
2	1.0263	.52639	.29353	.57761	-.40121E-01	-.10955E-01
3	2.0526	.60316	.24611	1.2234	-.25012E-01	-.62846E-02
4	3.0789	.63207	.20020	1.9350	-.24274E-01	-.81391E-02
5	4.1053	1.0145	.15547	2.7106	-.18881E-01	-.74517E-02
6	5.1316	1.1515	.11164	3.5085	-.15477E-01	-.75496E-02
7	6.1579	1.2439	.68439E-01	4.4479	-.11952E-01	-.73645E-02
8	7.1842	1.2921	.25613E-01	5.4078	-.83169E-02	-.70718E-02
9	8.2105	1.3000	0.	6.4233	.31078E-01	-.28112E-02
10	9.2368	1.3000	0.	7.4496	.35295E-02	.47755E-02
11	10.2632	1.3000	0.	8.4760	.34046E-02	.39930E-02
12	11.2895	1.3000	0.	9.5023	.14152E-02	.34673E-02
13	12.3158	1.3000	0.	10.529	.93969E-03	.26432E-02
14	13.3421	1.3000	0.	11.555	.55466E-03	.17866E-02
15	14.3684	1.3000	0.	12.581	.36257E-03	.10708E-02
16	15.3947	1.3000	0.	13.608	.23850E-03	.54355E-03
17	16.4211	1.3000	0.	14.634	.16227E-03	.22980E-03
18	17.4474	1.3000	0.	15.660	.11249E-03	.13410E-04

Figure 10.- Continued.

19	18.4737	1.3000	0.	1A.6AA	1.79559E-04	-.67235E-04
20	19.5000	1.3000	0.	17.713	.57218E-04	-.11629F-03
21	20.5263	1.3000	0.	1A.719	.41790E-04	-.17943F-03
22	21.5526	1.3000	0.	19.765	.30961E-04	-.45708E-04
23	22.5749	1.3000	0.	20.792	.23236E-04	-.75142E-04
24	23.6053	1.3000	0.	21.81A	.17650E-04	-.54633E-04
25	24.6316	1.3000	0.	22.840	.13558E-04	-.37078E-04
26	25.6579	1.3000	0.	23.871	.10525E-04	-.24532E-04
27	26.6842	1.3000	0.	24.897	.82509E-05	-.15475E-04
28	27.7105	1.3000	0.	25.923	.65280E-05	-.74713E-05
29	28.7368	1.3000	0.	26.950	.52101E-05	-.44327E-05
30	29.7632	1.3000	0.	27.976	.41922E-05	-.33202E-05
31	30.7895	1.3000	0.	29.002	.33993E-05	-.22844E-06
32	31.8158	1.3000	0.	30.029	.27768E-05	-.19378E-06
33	32.8421	1.3000	0.	31.055	.22835E-05	-.24675E-06
34	33.8684	1.3000	0.	32.081	.18903E-05	-.15784E-06
35	34.8947	1.3000	0.	33.108	.15745E-05	-.11691E-07
36	35.9211	1.3000	0.	34.134	.13191E-05	-.12245E-08
37	36.9474	1.3000	0.	35.160	.11112E-05	-.22221E-06
38	37.9737	1.3000	0.	36.186	.94102E-06	-.2A1AAE-0A
39	39.0000	1.3000	0.	37.213	0.	0.

PRESSURE COEFFICIENTS AT POINTS ON BODY MERIDIANS

J	THETA, DEG.	XA	YH	ZH	UTOT	VTOT	WTOT	CP,LIN.	CP,ERN.	DR/DX	P/PINF, ERN.	P/PINF, LIN.
BODY RING# 1												
1	11.25000	.51316	.16426	.03307	-.2040A	.34619	.16431	.40615	.31470	.31793	1.63664	1.82164
2	22.50000	.51316	.15662	.06447	-.142AA	.2890A	.22763	.36935	.24369	.31793	1.49299	1.74720
3	33.75000	.51316	.14095	.0941A	-.14071	.20227	.26242	.32942	.18128	.31793	1.36673	1.66642
4	45.00000	.51316	.11987	.11987	-.14395	.11616	.26874	.28789	.13035	.31793	1.26371	1.58241
5	56.25000	.51316	.0941A	.14095	-.1231A	.04000	.25033	.24637	.09186	.31793	1.18583	1.49840
6	67.50000	.51316	.06447	.15662	-.10322	-.01932	.21384	.20644	.06525	.31793	1.13200	1.41742
7	78.75000	.51316	.03307	.16426	-.08042	-.05811	.16768	.16964	.04898	.31793	1.09908	1.34318
8	90.00000	.51316	-.00000	.16952	-.04869	-.07629	.12065	.15738	.04083	.31793	1.08261	1.27792
9	101.25000	.51316	-.03307	.16626	-.05545	-.07713	.08050	.11091	.03528	.31793	1.07744	1.22437
10	112.50000	.51316	-.06447	.15662	-.04567	-.06654	.05275	.09124	.03876	.31793	1.07842	1.18458
11	123.75000	.51316	-.09418	.14095	-.03954	-.05195	.03986	.07913	.04007	.31793	1.08107	1.16007
12	135.00000	.51316	-.11987	.11987	-.03752	-.04093	.04093	.07504	.04069	.31793	1.08212	1.15180
13	146.25000	.51316	-.14095	.0941A	-.03956	-.03986	.05195	.07913	.04007	.31793	1.08107	1.14007
14	157.50000	.51316	-.15662	.06447	-.04562	-.05275	.06654	.09124	.03876	.31793	1.07842	1.118458
15	168.75000	.51316	-.16626	.03307	-.05545	-.08050	.07713	.11091	.03828	.31793	1.07744	1.22437
16	180.00000	.51316	-.16952	-.00000	-.06649	-.12065	.07629	.13738	.04083	.31793	1.08261	1.27792
17	191.25000	.51316	-.16426	-.03307	-.08042	-.16768	.05811	.16964	.04898	.31793	1.09908	1.34318
18	202.50000	.51316	-.15662	-.06447	-.10322	-.21384	.01932	.20644	.06525	.31793	1.13200	1.41742
19	213.75000	.51316	-.14095	-.0941A	-.1231A	-.25033	-.04000	.24637	.09186	.31793	1.18583	1.49840
20	225.00000	.51316	-.11987	-.11987	-.14395	-.26874	-.11616	.28789	.13035	.31793	1.26371	1.58241
21	236.25000	.51316	-.09418	-.14095	-.16071	-.26242	-.20227	.32942	.18128	.31793	1.36673	1.66642
22	247.50000	.51316	-.06447	-.15662	-.18068	-.22763	-.28906	.36935	.24369	.31793	1.49299	1.74720
23	258.75000	.51316	-.03307	-.16626	-.2050A	-.16431	-.36619	.40615	.31470	.31793	1.63664	1.82164
24	270.00000	.51316	-.00000	-.16952	-.21920	-.07629	-.42368	.43841	.3A919	.31793	1.74714	1.88690

Figure 10.- Continued.



25	291,25000	.51316	.03307	-.16626	-.21244	.02907	-.45337	.46488	.46006	.31793	1.93070	1.94045
26	292,50000	.51316	.03307	-.15642	-.24227	.14177	-.45019	.46455	.51904	.31793	2.05042	1.94024
27	303,75000	.51316	.03307	-.14095	-.24833	.25047	-.41274	.46666	.55827	.31793	2.12939	2.00475
28	315,00000	.51316	.03307	-.11987	-.25047	.34397	-.34397	.50075	.57705	.31793	2.15725	2.01302
29	326,25000	.51316	.03307	-.09018	-.24833	.41274	-.25047	.46666	.55827	.31793	2.12939	2.00475
30	337,50000	.51316	.03307	-.06047	-.24227	.45015	-.14177	.46455	.51904	.31793	2.05042	1.94024
31	348,75000	.51316	.03307	-.03076	-.21244	.45337	-.02907	.46488	.46006	.31793	1.93070	1.94045
32	360,00000	.51316	.03307	-.00000	-.21920	.42348	.07629	.41841	.38919	.31793	1.78734	1.88690

## BODY WING= 2

1	11,25000	2.56579	.70961	.14115	-.14124	.29958	.18203	.28247	.19422	.22298	1.39291	1.57144
2	22,50000	2.56579	.66443	.27647	-.12479	.21696	.23429	.24459	.12886	.22298	1.28069	1.50401
3	33,75000	2.56579	.60157	.40196	-.10695	.12713	.25530	.21390	.07368	.22298	1.16905	1.41773
4	45,00000	2.56579	.51160	.51160	-.08840	.04161	.24586	.17679	.03113	.22298	1.04297	1.34766
5	56,25000	2.56579	.40196	.60157	-.06984	.02944	.21090	.13969	.00171	.22298	1.00347	1.28258
6	67,50000	2.56579	.27647	.66443	-.05200	.07871	.15864	.10400	-.01550	.22298	.98844	1.21040
7	78,75000	2.56579	.14115	.70961	-.03556	.10271	.09915	.07112	-.02244	.22298	.95460	1.14387
8	90,00000	2.56579	-.00000	.72351	-.02115	.10212	.04282	.04229	-.02170	.22298	.95600	1.08556
9	101,25000	2.56579	-.14115	.70961	-.00932	.08155	-.00133	.01864	-.01633	.22298	.94695	1.03770
10	112,50000	2.56579	-.27647	.66443	-.00053	.06843	-.00106	.00950	-.00770	.22298	.94024	1.00214
11	123,75000	2.56579	-.40196	.60157	.00448	-.01272	-.03168	-.00977	-.00406	.22298	.94505	.97245
12	135,00000	2.56579	-.51160	.51160	.00671	.01671	-.01671	-.01342	-.00200	.22298	.99179	.98024
13	146,25000	2.56579	-.60157	.40196	.00448	.03168	.01272	-.00977	-.00406	.22298	.99179	.98024
14	157,50000	2.56579	-.66443	.27647	.00053	.02763	.04863	.00106	-.00950	.22298	.98024	1.00214
15	168,75000	2.56579	-.70961	.14115	-.00932	.08155	.01864	-.01633	.22298	.96695	1.03770	1.08556
16	180,00000	2.56579	-.72351	.00000	-.02115	.10212	.04282	-.02170	.22298	.95600	1.14387	1.21040
17	191,25000	2.56579	-.70961	.14115	-.03556	.10271	.09915	.07112	.22298	.94695	1.28258	1.34766
18	202,50000	2.56579	-.66443	.27647	-.05200	.15864	.07871	.10400	.22298	.98844	1.21040	1.50401
19	213,75000	2.56579	-.60157	.40196	-.06984	.21090	.13969	.00171	.22298	1.00347	1.28258	1.34766
20	225,00000	2.56579	-.51160	.51160	-.08840	.24586	.17679	.03113	.22298	1.04297	1.34766	1.41773
21	236,25000	2.56579	-.40196	.60157	-.10695	.25530	.21390	.07368	.22298	1.16905	1.41773	1.50401
22	247,50000	2.56579	-.27647	.66443	-.12479	.23429	.21696	.24459	.12886	.22298	1.28069	1.50401
23	258,75000	2.56579	-.14115	.70961	-.14124	.29958	.28247	.19422	.22298	1.39291	1.57144	1.57144
24	270,00000	2.56579	.00000	.72351	-.15565	.10212	.38372	.31130	.28490	.22298	1.53549	1.62975
25	281,25000	2.56579	.14115	.70961	-.16748	-.00223	.40006	.33495	.33372	.22298	1.67511	1.67761
26	292,50000	2.56579	.27647	.66443	-.17627	.10695	.40263	.35253	.39199	.22298	1.79299	1.71317
27	303,75000	2.56579	.40196	.60157	-.18168	.21315	.36971	.36335	.43119	.22298	1.87230	1.73507
28	315,00000	2.56579	.51160	.51160	-.19350	.30418	.30418	.36701	.44503	.22298	1.90030	1.70246
29	326,25000	2.56579	.60157	.40196	-.18168	.36971	.21315	.36335	.43119	.22298	1.87230	1.73507
30	337,50000	2.56579	.66443	.27647	-.17627	.40263	.35253	.39199	.44503	.22298	1.79299	1.71317
31	348,75000	2.56579	.70961	.14115	-.16748	.40006	.40223	.33495	.33372	.22298	1.67511	1.67761
32	360,00000	2.56579	.72351	.00000	-.15565	.36372	.10212	.31130	.28490	.22298	1.53549	1.62975

## BODY RING= 3

1	11,25000	4.61842	1.06771	.21238	-.08033	.22574	.20094	.16066	.06949	.13346	1.14139	1.32501
2	22,50000	4.61842	1.00576	.41660	-.06680	.13775	.24102	.13359	.01221	.13346	1.02471	1.27026
3	33,75000	4.61842	.90516	.60481	-.05211	.04519	.24720	.10423	-.03411	.13346	.91100	1.21045
4	45,00000	4.61842	.76977	.76977	-.03684	-.03919	.22098	.07369	-.06712	.13346	.84423	1.10907
5	56,25000	4.61842	.60516	.90516	-.02157	.10436	.16857	.04315	-.08669	.13346	.82461	1.08729
6	67,50000	4.61842	.41660	1.00576	-.00680	.14264	.09977	.01374	-.09400	.13346	.80995	1.02788
7	78,75000	4.61842	.21238	1.06771	.00680	.15070	.02641	-.01328	-.09112	.13346	.81547	.97313
8	90,00000	4.61842	.00000	1.08843	.01850	.13004	.03951	-.04701	-.08092	.13346	.83630	.92514
9	101,25000	4.61842	.21238	1.06771	.02824	.08672	.00768	-.05647	-.06693	.13346	.84461	.88575
10	112,50000	4.61842	.41660	1.00576	.05547	.03020	-.11104	-.07094	-.05393	.13346	.89273	.85409

Figure 10.- Continued.

11	123,75000	4,61842	-1,00516	-1,00516	-0,03992	-0,02825	-1,10687	-0,07985	-0,04289	1,13346	0,91324	0,83847
12	135,00000	4,61842	-1,76977	-1,76977	-0,04103	-0,07716	-0,07716	-0,08286	-0,03918	1,13346	0,92073	0,83238
13	146,25000	4,61842	-1,90516	-1,90516	-0,04041	-0,03992	-1,0687	-0,02825	-0,07985	1,13346	0,91324	0,83847
14	157,50000	4,61842	-1,00576	-1,00576	-0,04100	-0,03947	-1,11104	-0,03020	-0,07094	1,13346	0,9273	0,85649
15	168,75000	4,61842	-1,06771	-1,06771	-0,21238	-0,07824	-0,08677	-0,05647	-0,06693	1,13346	0,86461	0,88575
16	180,00000	4,61842	-1,02445	-1,02445	-0,00000	-0,01850	-0,03951	-1,13008	-0,03701	1,13346	0,08092	0,92514
17	191,25000	4,61842	-1,06771	-1,06771	-0,21238	-0,06644	-0,02601	-1,15070	-0,01328	1,13346	0,09112	0,81567
18	202,50000	4,61842	-1,01576	-1,01576	-0,41860	-0,06899	-0,09977	-1,14264	-0,01378	1,13346	0,09400	1,02788
19	213,75000	4,61842	-1,90516	-1,90516	-0,04041	-0,02157	-1,16857	-1,0436	-0,04315	1,13346	0,08669	1,08729
20	225,00000	4,61842	-1,76977	-1,76977	-0,03644	-0,22098	-0,03919	-0,07369	-0,04712	1,13346	0,86423	1,14907
21	236,25000	4,61842	-1,90516	-1,90516	-0,05211	-0,24720	-0,04519	-1,10423	-0,03411	1,13346	0,91100	1,21085
22	247,50000	4,61842	-1,06600	-1,06600	-0,06680	-0,24102	-0,13775	-1,13359	-0,01221	1,13346	1,02471	1,27026
23	258,75000	4,61842	-1,06771	-1,06771	-0,08033	-0,20086	-0,22574	-1,16066	-0,04949	1,13346	1,14139	1,32501
24	270,00000	4,61842	-0,00000	-1,08863	-0,09219	-1,13008	-0,29660	-1,18438	-1,1453	1,13346	1,27215	1,37300
25	281,25000	4,61842	-1,06771	-1,06771	-0,10192	-0,03661	-0,35981	-1,20345	-1,0915	1,13346	1,40288	1,41234
26	292,50000	4,61842	-1,06600	-1,06600	-1,10916	-0,06818	-0,34857	-1,21831	-1,25494	1,13346	1,51574	1,44164
27	303,75000	4,61842	-1,90516	-1,90516	-1,11361	-1,17109	-0,32064	-1,22722	-1,29296	1,13346	1,59265	1,45967
28	315,00000	4,61842	-1,76977	-1,76977	-1,11511	-1,25495	-0,25895	-1,21023	-1,30647	1,13346	1,61998	1,46575
29	326,25000	4,61842	-1,90516	-1,90516	-1,11361	-1,32064	-0,17108	-1,22722	-1,29296	1,13346	1,59265	1,45967
30	337,50000	4,61842	-1,06576	-1,06576	-1,10916	-0,34857	-0,06818	-1,21831	-1,25494	1,13346	1,51574	1,44164
31	348,75000	4,61842	-1,06771	-1,06771	-1,10192	-0,35981	-0,03661	-1,20345	-1,0915	1,13346	1,40288	1,41234
32	360,00000	4,61842	-1,08863	-0,00000	-0,09219	-0,29660	-1,13008	-1,18438	-1,1453	1,13346	1,27215	1,37300

# ADDY RING# 4

1	11,25000	6,67105	1,24902	2,24845	-0,01697	1,14328	2,22303	0,33594	-0,06231	0,04699	0,87392	1,06867
2	22,50000	6,67105	1,17655	0,48734	-0,00804	0,49966	2,50004	0,16008	-1,10916	0,04699	0,77918	1,03254
3	33,75000	6,67105	1,05887	0,70751	-0,00165	-0,04565	2,40117	-0,00329	-1,14409	0,04699	0,70850	0,99334
4	45,00000	6,67105	0,90049	0,90049	-0,01172	-1,12864	1,9587	-0,02345	-1,16569	0,04699	0,66481	0,95257
5	56,25000	6,67105	0,70751	1,05887	-0,02180	-1,14744	1,2471	-0,04360	-1,17404	0,04699	0,64791	0,91180
6	67,50000	6,67105	0,48734	1,17655	-0,03149	-0,21365	0,03819	-0,06298	-1,17024	0,04699	0,65560	0,87260
7	78,75000	6,67105	0,24845	1,24902	-0,04022	-0,20408	-0,05002	-0,08084	-1,15623	0,04699	0,63394	0,83647
8	90,00000	6,67105	-0,00000	1,27349	-0,04825	-1,16226	-0,12618	-0,09649	-1,13405	0,04699	0,72699	0,80480
9	101,25000	6,67105	-0,24845	1,24902	-0,05467	-0,09406	-1,17860	-1,10934	-1,11043	0,04699	0,77659	0,77841
10	112,50000	6,67105	-0,48734	1,17655	-0,05904	-0,01246	-1,19939	-1,11888	-0,07558	0,04699	0,82282	0,75950
11	123,75000	6,67105	-0,70751	1,05887	-0,06238	-0,07024	-1,18570	-1,12476	-0,07135	0,04699	0,85566	0,74761
12	135,00000	6,67105	-0,90049	0,90049	-0,06337	-1,14011	-1,12675	-0,06547	-0,07135	0,04699	0,86756	0,74359
13	146,25000	6,67105	-1,05887	0,70751	-0,06238	-1,18570	-0,07024	-1,12476	-0,07135	0,04699	0,85566	0,74761
14	157,50000	6,67105	-1,17655	0,48734	-0,05904	-1,19939	-0,12496	-1,11888	-0,07558	0,04699	0,82282	0,75950
15	168,75000	6,67105	-1,24902	0,24845	-0,05467	-1,17860	-0,09406	-1,10934	-1,11043	0,04699	0,77659	0,77841
16	180,00000	6,67105	-1,27349	-0,00000	-0,04825	-1,16226	-0,12618	-0,09649	-1,13405	0,04699	0,72699	0,80480
17	191,25000	6,67105	-1,24902	-0,24845	-0,04022	-0,20408	-0,05002	-0,08084	-1,15623	0,04699	0,63394	0,83647
18	202,50000	6,67105	-1,17655	-0,48734	-0,03149	-0,21365	-0,03819	-0,06298	-1,17024	0,04699	0,65560	0,87260
19	213,75000	6,67105	-1,05887	-0,70751	-0,02180	-1,14744	-1,12471	-0,04360	-1,17404	0,04699	0,64791	0,91180
20	225,00000	6,67105	-0,90049	-0,90049	-0,01172	-1,12864	-1,2864	-0,02345	-1,16569	0,04699	0,66481	0,95257
21	236,25000	6,67105	-0,70751	-1,05887	-0,0165	-1,24017	0,04565	-0,00329	-1,14409	0,04699	0,70850	0,99334
22	247,50000	6,67105	-0,48734	-1,17655	-0,00804	-0,49966	-0,04966	-0,16008	-1,10916	0,04699	0,77918	1,03254
23	258,75000	6,67105	-0,24845	-1,24902	-0,01697	-1,14328	0,33594	-0,06231	-0,04699	0,87392	1,06867	
24	270,00000	6,67105	-0,00000	-1,27349	-0,02480	-1,16226	-0,12618	-0,09649	-1,13405	0,04699	0,72699	0,80480
25	281,25000	6,67105	0,24845	-1,24902	-0,03122	-0,07591	-0,27186	-0,06244	-0,04963	0,04699	1,10000	1,12632
26	292,50000	6,67105	0,48734	-1,17655	-0,03600	-0,28724	-0,12307	-0,07149	-0,09497	0,04699	1,20223	1,14564
27	303,75000	6,67105	0,70751	-1,05887	-0,03893	-0,26476	-0,13482	-0,07787	-0,10482	0,04699	1,27274	1,15753
28	315,00000	6,67105	0,90049	-0,90049	-0,03993	-0,20755	-0,20755	-0,07985	-0,14730	0,04699	1,29799	1,16154
29	326,25000	6,67105	1,05887	-0,70751	-0,03893	-0,26476	-0,13482	-0,07787	-0,10482	0,04699	1,27274	1,15753
30	337,50000	6,67105	1,17655	-0,48734	-0,03600	-0,28724	-0,12307	-0,07149	-0,09497	0,04699	1,20223	1,14564
31	348,75000	6,67105	1,24902	-0,24845	-0,03122	-0,27186	-0,07591	-0,06244	-0,04963	0,04699	1,10000	1,12632
32	360,00000	6,67105	1,27349	-0,00000	-0,02480	-0,22127	-0,16226	-0,04960	-0,00729	0,04699	0,98525	1,10034

Figure 10.- Continued.

## BODY RING= 5

BODY NOSE SEPARATION AT XH/RH = 5.52485  
 VORTEX STRENGTH GAMMA/(2\*PI\*RLOC\*VINF) = .07510  
 VORTEX Y/RLOC (UNROLLED COORDS) = .63291  
 VORTEX Z/RLOC (UNROLLED COORDS) = 1.17494

RIGHT VORTEX STRENGTH GAMMA/(2\*PI\*RLOC\*VINF) = .07510  
 RIGHT VORTEX Y(ROLLED COORDS,1/RLOC) = -.38327  
 RIGHT VORTEX Z(ROLLED COORDS,1/RLOC) = 1.27835  
 LEFT VORTEX STRENGTH GAMMA/(2\*PI\*RLOC\*VINF) = -.07510  
 LEFT VORTEX Y(ROLLED COORDS,1/RLOC) = -1.27835  
 LEFT VORTEX Z(ROLLED COORDS,1/RLOC) = .38327

1	11.25000	8.72368	1.27502	.25362	.01444	.09244	.24186	-.03692	-.13846	0.00000	.71989	.92531
2	22.50000	8.72368	1.20104	.49749	.02098	-.00455	.25906	-.04195	-.17259	0.00000	.65086	.91513
3	33.75000	8.72368	1.08091	.72224	.02371	-.04954	.23610	-.04742	-.19340	0.00000	.60875	.90407
4	45.00000	8.72368	.91924	.91924	.02655	-.17601	.17601	-.05410	-.19873	0.00000	.59797	.89257
5	56.25000	8.72368	.72224	1.08091	.02939	-.21820	.08758	-.05879	-.18674	0.00000	.62223	.88108
6	67.50000	8.72368	.49749	1.20104	.03213	-.21115	-.01531	-.06425	-.15486	0.00000	.68673	.87002
7	78.75000	8.72368	.25362	1.27502	.03484	-.13649	-.11342	-.06929	-.09967	0.00000	.79837	.85983
8	90.00000	8.72368	-.00000	1.30000	.03685	.03919	-.17544	-.07370	-.02991	0.00000	.93950	.85090
9	101.25000	8.72368	-.25362	1.27502	.03866	.31798	-.14709	-.07733	-.03667	0.00000	.92583	.84357
10	112.50000	8.72368	-.49749	1.20104	.04001	.37297	-.09363	-.08002	-.06200	0.00000	.87458	.83812
11	123.75000	8.72368	-.72224	1.08091	.04084	.23609	-.13492	-.08168	-.02545	0.00000	.94852	.83477
12	135.00000	8.72368	-.91924	.91924	.04112	.04112	.17544	-.08224	-.02079	0.00000	.95705	.83364
13	146.25000	8.72368	-1.08091	.72224	.04084	.13492	.23609	-.08168	-.02545	0.00000	.94852	.83477
14	157.50000	8.72368	-1.20104	.49749	.04001	.09363	.37297	-.08002	-.06200	0.00000	.87458	.83812
15	168.75000	8.72368	-1.27502	.25362	.03866	.14709	.31798	-.07733	-.03667	0.00000	.92583	.84357
16	180.00000	8.72368	-1.30000	-.00000	.03685	.17544	-.03919	-.07370	-.02991	0.00000	.93950	.85090
17	191.25000	8.72368	-1.27502	-.25362	.03484	.11342	.13639	-.06929	-.09967	0.00000	.79837	.85983
18	202.50000	8.72368	-1.20104	-.49749	.03213	.01531	.21115	-.06425	-.15486	0.00000	.68673	.87002
19	213.75000	8.72368	-1.08091	-.72224	.02939	-.08758	.21820	-.05879	-.18674	0.00000	.62223	.88108
20	225.00000	8.72368	-.91924	-.91924	.02655	-.17601	.17601	-.05410	-.19873	0.00000	.59797	.89257
21	236.25000	8.72368	-.72224	-1.08091	.02371	-.23610	.09954	-.04742	-.19340	0.00000	.60875	.90407
22	247.50000	8.72368	-.49749	-1.20104	.02098	.25906	.00453	-.04195	-.17259	0.00000	.65086	.91513
23	258.75000	8.72368	-.25362	-1.27502	.01444	.24186	.09244	-.03692	-.13846	0.00000	.71989	.92531
24	270.00000	8.72368	.00000	-1.30000	.01625	-.18759	-.04250	-.09467	-.00000	0.00000	.80849	.93075
25	281.25000	8.72368	.25362	-1.27502	.01444	-.10489	.23121	-.02888	-.04710	0.00000	.90472	.94157
26	292.50000	8.72368	.49749	-1.20104	.01309	-.00468	.25088	-.02619	-.00372	0.00000	.99247	.94702
27	303.75000	8.72368	.72224	-1.08091	.01227	.09183	.23132	-.02453	.02686	0.00000	1.05435	.95037
28	315.00000	8.72368	.91924	-.91924	.01199	.17544	-.17544	-.02497	.03792	0.00000	1.07671	.95151
29	326.25000	8.72368	1.08091	-.72224	.01227	.23132	-.09183	-.02453	.02686	0.00000	1.05435	.95037
30	337.50000	8.72368	1.20104	-.49749	.01309	.25088	.00668	-.02619	-.00372	0.00000	.99247	.94702
31	348.75000	8.72368	1.27502	-.25362	.01444	.23121	.10489	-.02888	-.04710	0.00000	.90472	.94157
32	360.00000	8.72368	1.30000	.00000	.01625	.17544	.18759	-.03250	-.09467	0.00000	.80849	.93075

## BODY RING= 6

BODY NOSE SEPARATION AT XH/RH = 5.52485  
 VORTEX STRENGTH GAMMA/(2\*PI\*RLOC\*VINF) = .07701  
 VORTEX Y/RLOC (UNROLLED COORDS) = .63679  
 VORTEX Z/RLOC (UNROLLED COORDS) = 1.22147

Figure 10.- Continued.

RIGHT VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINP) = .07701  
 RIGHT VORTEX Y(ROLLED CHORDS,)/RLUC = -.41303  
 RIGHT VORTEX Z(ROLLED CHORDS,)/RLUC = 1.31399  
 LEFT VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINP) = -.07701  
 LEFT VORTEX Y(ROLLED CHORDS,)/RLUC = -1.31399  
 LEFT VORTEX Z(ROLLED CHORDS,)/RLUC = .41303

1	11.25000	10.77632	1.27502	.25362	.01723	.09167	.24573	-.03446	-.13919	0.00000	.71841	.93030
2	22.50000	10.77632	1.20104	.49749	.01669	-.00614	.26294	-.03338	-.16925	0.00000	.65760	.93247
3	33.75000	10.77632	1.08091	.72224	.01611	-.10186	.23957	-.03222	-.18568	0.00000	.62437	.93482
4	45.00000	10.77632	.91924	.91924	.01550	-.17871	.17871	-.03101	-.18601	0.00000	.62371	.93727
5	56.25000	10.77632	.72224	1.08091	.01490	-.22080	.04932	-.02980	-.16797	0.00000	.66019	.93972
6	67.50000	10.77632	.49749	1.20104	.01432	-.21334	-.01441	-.02863	-.12865	0.00000	.73975	.94207
7	78.75000	10.77632	.25362	1.27502	.01378	-.13943	-.11281	-.02756	-.04501	0.00000	.86848	.94424
8	90.00000	10.77632	-.00000	1.30000	.01331	-.02598	-.17544	-.02662	.01263	0.00000	1.02555	.94615
9	101.25000	10.77632	-.25362	1.27502	.01292	.27244	-.15615	-.02585	.02547	0.00000	1.05153	.94771
10	112.50000	10.77632	-.49749	1.20104	.01244	.34955	-.10333	-.02528	-.00024	0.00000	.99952	.94887
11	123.75000	10.77632	-.72224	1.08091	.01246	.24047	-.13199	-.02492	.03044	0.00000	1.06158	.94958
12	135.00000	10.77632	-.91924	.91924	.01240	.17544	-.17544	-.02480	.03706	0.00000	1.07497	.94982
13	146.25000	10.77632	-1.08091	.72224	.01244	.13199	-.24047	-.02492	.03044	0.00000	1.06158	.94958
14	157.50000	10.77632	-1.20104	.49749	.01244	.10333	-.34955	-.02528	-.00024	0.00000	.99952	.94887
15	168.75000	10.77632	-1.27502	.25362	.01292	.15615	-.27244	-.02585	.02547	0.00000	1.05153	.94771
16	180.00000	10.77632	-1.30000	-.00000	.01331	.17544	-.02598	-.02662	.01263	0.00000	1.02555	.94615
17	191.25000	10.77632	-1.27502	-.25362	.01378	.11281	.13943	-.02756	-.06501	0.00000	.86848	.94424
18	202.50000	10.77632	-1.20104	-.49749	.01432	.01441	.21334	-.02863	-.12865	0.00000	.73975	.94207
19	213.75000	10.77632	-1.08091	-.72224	.01490	-.04932	.22080	-.02980	-.16797	0.00000	.66019	.93972
20	225.00000	10.77632	-.91924	-.91924	.01550	-.17871	.17871	-.03101	-.18601	0.00000	.62371	.93727
21	236.25000	10.77632	-.72224	-1.08091	.01611	-.23957	.10186	-.03222	-.18568	0.00000	.62437	.93482
22	247.50000	10.77632	-.49749	-1.20104	.01669	-.26294	.00614	-.03338	-.16925	0.00000	.65760	.93247
23	258.75000	10.77632	-.25362	-1.27502	.01723	-.24573	-.09167	-.03446	-.13919	0.00000	.71841	.93030
24	270.00000	10.77632	-.00000	-1.30000	.01770	-.19104	-.17544	-.03540	-.09925	0.00000	.79922	.92839
25	281.25000	10.77632	.25362	-1.27502	.01808	-.10759	-.23174	-.03617	-.05520	0.00000	.88833	.92683
26	292.50000	10.77632	.49749	-1.20104	.01837	-.00846	-.25162	-.03674	-.01473	0.00000	.97021	.92567
27	303.75000	10.77632	.72224	-1.08091	.01855	.09101	-.23186	-.03709	.01392	0.00000	1.02817	.92496
28	315.00000	10.77632	.91924	-.91924	.01861	.17544	-.17544	-.03721	.02430	0.00000	1.04915	.92472
29	326.25000	10.77632	1.08091	-.72224	.01855	.23186	-.09101	-.03709	.01392	0.00000	1.02817	.92496
30	337.50000	10.77632	1.20104	-.49749	.01837	.25162	.00846	-.03674	-.01473	0.00000	.97021	.92567
31	348.75000	10.77632	1.27502	-.25362	.01808	.23174	.10759	-.03617	-.05520	0.00000	.88833	.92683
32	360.00000	10.77632	1.30000	.00000	.01770	.17544	.19104	-.03540	-.09925	0.00000	.79922	.92839

BODY RING# 7

BODY NOSE SEPARATION AT XB/RH = 5.52485  
 VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINP) = .07891  
 VORTEX Y/RLUC (UNROLLED CHORDS) = .64087  
 VORTEX Z/RLUC (UNROLLED CHORDS) = 1.24800

RIGHT VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINP) = .07891  
 RIGHT VORTEX Y(ROLLED CHORDS,)/RLUC = -.44345  
 RIGHT VORTEX Z(ROLLED CHORDS,)/RLUC = 1.34977  
 LEFT VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINP) = -.07891  
 LEFT VORTEX Y(ROLLED CHORDS,)/RLUC = -1.34977  
 LEFT VORTEX Z(ROLLED CHORDS,)/RLUC = .44345

1	11.25000	12.82895	1.27502	.25362	.01336	.09328	.23765	-.02672	-.12754	0.00000	.74199	.94594
2	22.50000	12.82895	1.20104	.49749	.01226	-.00257	.25433	-.02452	-.15614	0.00000	.68412	.95039

Figure 10.- Continued.

3	33.75000	12.82895	1.08091	.72224	.01197	-.00422	.23113	-.02214	-.17124	0.00000	.65354	.94522
4	45.00000	12.82895	.91924	.91924	.00943	-.17112	.17112	-.01945	-.17022	0.00000	.65444	.94624
5	56.25000	12.82895	.72224	1.04031	.00958	-.21166	.00321	-.01717	-.15079	0.00000	.65495	.94627
6	67.50000	12.82895	.49749	1.20104	.00739	-.20344	-.01850	-.01478	-.11026	0.00000	.77695	.97010
7	78.75000	12.82895	.25362	1.27502	.00629	-.15127	-.11444	-.01258	-.04674	0.00000	.90544	.97455
8	90.00000	12.82895	.00000	1.30000	.00533	-.02363	-.17544	-.01065	.02799	0.00000	1.04443	.97845
9	101.25000	12.82895	-.25362	1.27502	.00450	.24321	-.16196	-.00907	.04810	0.00000	1.09731	.98165
10	112.50000	12.82895	-.49749	1.20104	.00395	.32994	-.11145	-.00790	.02477	0.00000	1.09012	.98603
11	123.75000	12.82895	-.72224	1.04031	.00359	.24358	-.12992	-.00717	.04813	0.00000	1.09736	.98449
12	135.00000	12.82895	-.91924	.91924	.00346	.17544	-.17544	-.00695	.05568	0.00000	1.11264	.98599
13	146.25000	12.82895	-1.08091	.72224	.00359	.12992	-.24358	-.00717	.04813	0.00000	1.09736	.98549
14	157.50000	12.82895	-1.20104	.49749	.00395	.11145	-.32994	-.00790	.02477	0.00000	1.09012	.98403
15	168.75000	12.82895	-1.27502	.25362	.00450	.16196	-.24321	-.00907	.04810	0.00000	1.09731	.98165
16	180.00000	12.82895	-1.30000	.00000	.00533	.17544	-.02363	-.01065	.02799	0.00000	1.09563	.97845
17	191.25000	12.82895	-1.27502	.25362	.00450	.11444	.15127	-.01258	-.04674	0.00000	.90544	.97455
18	202.50000	12.82895	-1.20104	.49749	.00395	.00739	.20344	-.01478	-.11026	0.00000	.77695	.97010
19	213.75000	12.82895	-1.08091	.72224	.00359	-.08321	.21166	-.01717	-.15079	0.00000	.65495	.94627
20	225.00000	12.82895	-.91924	.91924	.00346	-.17112	.17112	-.01945	-.17022	0.00000	.65444	.94624
21	236.25000	12.82895	-.72224	-1.04031	.00359	-.23113	.09622	-.02214	-.17124	0.00000	.65354	.94522
22	247.50000	12.82895	-.49749	-1.20104	.00726	-.25433	.00257	-.02452	-.15014	0.00000	.65412	.95039
23	258.75000	12.82895	-.25362	-1.27502	.00336	-.23765	-.09328	-.02672	-.12754	0.00000	.74199	.94594
24	270.00000	12.82895	.00000	-1.30000	.01433	-.18411	-.17544	-.02865	-.08423	0.00000	.81948	.94244
25	281.25000	12.82895	.25362	-1.27502	.01512	-.10230	-.03023	-.04694	0.00000	0.00000	.94503	.93844
26	292.50000	12.82895	.49749	-1.20104	.01570	-.00504	-.25020	-.03141	-.00813	0.00000	.98356	.93649
27	303.75000	12.82895	.72224	-1.04031	.01607	.09257	-.25082	-.04213	.01932	0.00000	1.03909	.93499
28	315.00000	12.82895	.91924	-.91924	.01619	.17544	-.17544	-.03238	.02925	0.00000	1.05918	.93450
29	326.25000	12.82895	1.08091	.72224	.01607	.23042	-.09257	-.03213	.01932	0.00000	1.03909	.93499
30	337.50000	12.82895	1.20104	.49749	.01570	.00504	-.05141	-.00813	0.00000	0.00000	.98356	.93649
31	348.75000	12.82895	1.27502	-.25362	.01512	.23069	.10230	-.03023	-.04694	0.00000	.94503	.93844
32	360.00000	12.82895	1.30000	.00000	.01433	.17544	.18411	-.02865	-.08423	0.00000	.81948	.94244

## BODY PINGS A

BODY NOSE SEPARATION AT X/RH = 5.52485  
 VORTEX STRENGTH  $\Gamma/(2\pi RLOC \cdot VINF)$  = .00092  
 VORTEX Y/RLOC (UNROLLLED CHORDS) = .64591  
 VORTEX Z/RLOC (UNROLLLED CHORDS) = 1.31451

RIGHT VORTEX STRENGTH  $\Gamma/(2\pi RLOC \cdot VINF)$  = .00082  
 RIGHT VORTEX Y (ROLLLED CHORDS, )/RLOC = -.47279  
 RIGHT VORTEX Z (ROLLLED CHORDS, )/RLOC = 1.38624  
 LEFT VORTEX STRENGTH  $\Gamma/(2\pi RLOC \cdot VINF)$  = -.00082  
 LEFT VORTEX Y (ROLLLED CHORDS, )/RLOC = -1.38624  
 LEFT VORTEX Z (ROLLLED CHORDS, )/RLOC = .47279

1	11.25000	14.88158	1.27502	.25362	.00928	.09490	.22946	-.01855	-.11532	0.00000	.78670	.96247
2	22.50000	14.88158	1.20104	.49749	.00804	.08103	.24562	-.01691	-.14371	0.00000	.78927	.96579
3	33.75000	14.88158	1.04031	.72224	.00757	-.09054	.22262	-.01513	-.15873	0.00000	.78844	.96939
4	45.00000	14.88158	.91924	.91924	.00644	-.16351	.16351	-.01378	-.15776	0.00000	.64084	.97314
5	56.25000	14.88158	.72224	1.04031	.00571	-.20245	.07712	-.01143	-.13858	0.00000	.71965	.97689
6	67.50000	14.88158	.49749	1.20104	.00482	-.19377	-.02251	-.00944	-.04890	0.00000	.79993	.98069
7	78.75000	14.88158	-.25362	1.27502	.00400	-.12339	-.11400	-.00800	-.03793	0.00000	.92326	.98391
8	90.00000	14.88158	.00000	1.30000	.00328	.02217	-.17544	-.00656	.03149	0.00000	1.04410	.98472
9	101.25000	14.88158	-.25362	1.27502	.00269	.22012	-.16654	-.00438	.05492	0.00000	1.11111	.99011
10	112.50000	14.88158	-.49749	1.20104	.00224	.10040	-.11955	-.00451	.03517	0.00000	1.07114	.99049
11	123.75000	14.88158	-.72224	1.04031	.00198	.24356	-.12993	-.00397	.05147	0.00000	1.10412	.99194
12	135.00000	14.88158	-.91924	.91924	.00189	.17544	-.17544	-.00378	.05899	0.00000	1.11933	.99245

Figure 10.- Continued.

13	146,25000	14,8A158	-1,0A091	.72224	.0019A	.12993	-.24356	-.00397	.05147	0,00000	1,1A412	.9919A
14	157,50000	14,8A158	-1,20104	.49749	.00224	.11955	-.31040	-.00451	.03517	0,00000	1,07114	.99089
15	168,75000	14,8A158	-1,27502	.25362	.00249	.16654	-.22012	-.00538	.05492	0,00000	1,11111	.9A911
16	180,00000	14,8A158	-1,30000	.00000	.00328	.17544	-.02217	-.00654	.03149	0,00000	1,06410	.9A672
17	191,25000	14,8A158	-1,27502	-.25362	.00400	.11609	.12339	-.00800	-.03793	0,00000	.92326	.9A381
18	202,50000	14,8A158	-1,20104	-.49749	.00442	.02251	.19377	-.00964	-.00890	0,00000	.79993	.9A049
19	213,75000	14,8A158	-1,0A091	-.72224	.00571	-.07712	.20255	-.01143	-.13858	0,00000	.71945	.97689
20	225,00000	14,8A158	-.91924	-.91924	.00644	-.16351	.16351	-.01328	-.15776	0,00000	.6A044	.97314
21	236,25000	14,8A158	-.72224	-1,08091	.00757	-.22242	.09054	-.01513	-.15873	0,00000	.67888	.96939
22	247,50000	14,8A158	-.49749	-1,20104	.00846	-.24562	-.00103	-.01691	-.14371	0,00000	.70927	.96579
23	258,75000	14,8A158	-.25362	-1,27502	.00928	-.22944	-.09490	-.01855	-.11532	0,00000	.76670	.96247
24	270,00000	14,8A158	.00000	-1,30000	.01000	-.17709	.17544	-.01499	-.07743	0,00000	.84337	.95956
25	281,25000	14,8A158	.25362	-1,27502	.01059	-.09693	-.22962	-.02117	-.03571	0,00000	.92775	.95717
26	292,50000	14,8A158	.49749	-1,20104	.01102	-.00157	-.24877	-.02205	.00247	0,00000	1,00500	.95539
27	303,75000	14,8A158	.72224	-1,08091	.01130	.09416	-.22976	-.02259	.07942	0,00000	1,05952	.95430
28	315,00000	14,8A158	.91924	-.91924	.01139	.17544	-.17544	-.02277	.05916	0,00000	1,07922	.95393
29	326,25000	14,8A158	1,0A091	-.72224	.01130	.22976	-.09416	-.02259	.02942	0,00000	1,05952	.95430
30	337,50000	14,8A158	1,20104	-.49749	.01102	.24877	.00157	-.02205	.00247	0,00000	1,00500	.95539
31	348,75000	14,8A158	1,27502	-.25362	.01059	.22962	.09693	-.02117	-.03571	0,00000	.92775	.95717
32	360,00000	14,8A158	1,30000	.00000	.01000	.17544	.17709	-.01499	-.07743	0,00000	.84337	.95956

# ANDY RINGS 9

RUDY NOSE SEPARATION AT XH/RR = 5,52485  
 VORTEX STRENGTH GAMMA/(2\*PI\*RLC\*VINF) = .08272  
 VORTEX Y/RLC (UNROLLED COORDS) = .65095  
 VORTEX Z/RLC (UNROLLED COORDS) = 1,36106

RIGHT VORTEX STRENGTH GAMMA/(2\*PI\*RLC\*VINF) = .08272  
 RIGHT VORTEX Y(ROLLED COORDS,)/RLC = -.50213  
 RIGHT VORTEX Z(ROLLED COORDS,)/RLC = 1,42271  
 LEFT VORTEX STRENGTH GAMMA/(2\*PI\*RLC\*VINF) = -.08272  
 LEFT VORTEX Y(ROLLED COORDS,)/RLC = -1,42271  
 LEFT VORTEX Z(ROLLED COORDS,)/RLC = .50213

1	11,25000	16,93421	1,27502	.25362	.00617	.09596	.22413	-.01234	-.10656	0,00000	.78443	.97504
2	22,50000	16,93421	1,20104	.49749	.00572	.00339	.23992	-.01144	-.13511	0,00000	.72668	.97687
3	33,75000	16,93421	1,0A091	.72224	.00523	-.0A678	.21701	-.01046	-.15036	0,00000	.69592	.97884
4	45,00000	16,93421	.91924	.91924	.00472	-.15845	.15845	-.00944	-.14971	0,00000	.60714	.98090
5	56,25000	16,93421	.72224	1,08091	.00421	-.19647	.07306	-.00842	-.13103	0,00000	.73493	.98296
6	67,50000	16,93421	.49749	1,20104	.00372	-.18740	-.02515	-.00745	-.00241	0,00000	.81306	.98493
7	78,75000	16,93421	.25362	1,27502	.00327	-.11886	-.11690	-.00655	-.03396	0,00000	.93130	.98676
8	90,00000	16,93421	.00000	1,30000	.00288	.01863	-.17544	-.00576	.04137	0,00000	1,04346	.98835
9	101,25000	16,93421	-.25362	1,27502	.00255	.19951	-.17066	-.00511	.05697	0,00000	1,11504	.98966
10	112,50000	16,93421	-.49749	1,20104	.00231	.29103	-.12757	-.00463	.04108	0,00000	1,08311	.99064
11	123,75000	16,93421	-.72224	1,0A091	.00217	.24097	-.13166	-.00433	.05163	0,00000	1,10445	.99174
12	135,00000	16,93421	-.91924	.91924	.00212	.17544	-.17544	-.00423	.05852	0,00000	1,11838	.99144
13	146,25000	16,93421	-1,0A091	.72224	.00217	.13166	.24097	-.00433	.05163	0,00000	1,10445	.99174
14	157,50000	16,93421	-1,20104	.49749	.00211	.12757	-.29103	-.00463	.04108	0,00000	1,08311	.99064
15	168,75000	16,93421	-1,27502	.25362	.00255	.17066	-.19951	-.00511	.05697	0,00000	1,11504	.98966
16	180,00000	16,93421	-1,30000	.00000	.00288	.17544	-.01863	-.00576	.04137	0,00000	1,04346	.98835
17	191,25000	16,93421	-1,27502	-.25362	.00327	.11690	.11886	-.00655	-.03396	0,00000	.93130	.98676
18	202,50000	16,93421	-1,20104	-.49749	.00372	.18740	-.02515	-.00745	-.00241	0,00000	.81306	.98493
19	213,75000	16,93421	-1,0A091	-.72224	.00421	-.07306	.19647	-.00842	-.13103	0,00000	.73493	.98296
20	225,00000	16,93421	-.91924	.91924	.00472	-.15845	.15845	-.00944	-.14971	0,00000	.60714	.98090
21	236,25000	16,93421	-.72224	-1,08091	.00523	-.21701	.0A678	-.01046	-.15036	0,00000	.69592	.97884
22	247,50000	16,93421	-.49749	-1,20104	.00572	-.23992	-.00339	-.01144	-.13511	0,00000	.72668	.97687

Figure 10.- Continued.

23	258,75000	18,93421	-.25362	-1,27502	.00617	-.22413	-.09594	-.01244	-.10654	0,00000	.78441	.97504
24	270,00000	18,93421	.00000	-1,30000	.00644	-.17254	-.17544	-.01313	-.06841	0,00000	.84120	.97345
25	281,25000	18,93421	-.25362	-1,27502	.00649	-.02306	-.22891	-.01377	-.07695	0,00000	.94547	.97214
26	292,50000	18,93421	.49749	-1,20104	.00713	-.24784	-.24784	-.01426	-.01110	0,00000	1,02245	.97116
27	303,75000	18,93421	.72224	-1,08091	.00728	.09518	-.22908	-.01455	.03792	0,00000	1,07670	.97056
28	315,00000	18,93421	.91924	-.41924	.00733	.17544	-.17544	-.01445	.04760	0,00000	1,09639	.97016
29	326,25000	18,93421	1,08091	-.72224	.00728	.22908	-.09518	-.01455	.03792	0,00000	1,07670	.97056
30	337,50000	18,93421	1,20104	-.49749	.00713	.24784	-.00000	-.01426	.01110	0,00000	1,02245	.97116
31	348,75000	18,93421	1,27502	-.25362	.00649	.22891	.09346	-.01377	-.02695	0,00000	.94547	.97214
32	360,00000	18,93421	1,30000	.00000	.00644	.17544	.17254	-.01313	-.06841	0,00000	.84120	.97345

## BODY RING 10

BODY NOSE SEPARATION AT XM/NH = 5,52445  
 VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINF) = .08688  
 VORTEX V/RLOC (UNROLLED CHORDS) = .45576  
 VORTEX Z/RLOC (UNROLLED CHORDS) = 1,40759

HIGHT VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINF) = .08688  
 HIGHT VORTEX V/RLOC (UNROLLED CHORDS, 1/RLOC) = -.53143  
 HIGHT VORTEX Z/RLOC (UNROLLED CHORDS, 1/RLOC) = 1,45901  
 LEFT VORTEX STRENGTH GAMMA/(2\*PI\*RLUC\*VINF) = .08688  
 LEFT VORTEX V/RLOC (UNROLLED CHORDS, 1/RLOC) = -1,45901  
 LEFT VORTEX Z/RLOC (UNROLLED CHORDS, 1/RLOC) = .53143

1	11,25000	18,98684	1,27502	.25362	.00616	.09660	.22095	-.00632	-.10104	0,00000	.79560	.98318
2	22,50000	18,98684	1,20104	.49749	.00395	.00485	.21640	-.00791	-.12464	0,00000	.71774	.98401
3	33,75000	18,98684	1,08091	.72224	.00173	-.08436	.21339	-.00746	-.14044	0,00000	.70679	.98491
4	45,00000	18,98684	.91924	.91924	.00350	-.15498	.15498	-.00700	-.14430	0,00000	.70860	.98544
5	56,25000	18,98684	.72224	1,08091	.00327	-.19194	.07004	-.00653	-.12567	0,00000	.74577	.98678
6	67,50000	18,98684	.49749	1,20104	.00304	-.18211	-.02734	-.00609	-.08742	0,00000	.82315	.98748
7	78,75000	18,98684	.25362	1,27502	.00280	-.11911	-.11785	-.00568	-.01045	0,00000	.93444	.98851
8	90,00000	18,98684	.00000	1,30000	.00266	.01843	-.17544	-.00532	.03175	0,00000	1,04423	.98924
9	101,25000	18,98684	-.25362	1,27502	.00251	.18601	-.17295	-.00503	.05744	0,00000	1,11625	.98983
10	112,50000	18,98684	-.49749	1,20104	.00240	.27941	-.13230	-.00481	.04404	0,00000	1,08910	.99028
11	123,75000	18,98684	-.72224	1,08091	.00234	.24039	-.13295	-.00467	.05139	0,00000	1,10397	.99055
12	135,00000	18,98684	-.91924	.91924	.00231	.17544	-.17544	-.00463	.05810	0,00000	1,11754	.99064
13	146,25000	18,98684	-1,08091	.72224	.00230	.15265	-.24039	-.00467	.05139	0,00000	1,10397	.99055
14	157,50000	18,98684	-1,20104	.49749	.00230	.13230	-.27941	-.00461	.04404	0,00000	1,08910	.99028
15	168,75000	18,98684	-1,27502	.25362	.00231	.17295	-.18601	-.00503	.05744	0,00000	1,11625	.98983
16	180,00000	18,98684	-1,30000	.00000	.00244	.17544	-.01843	-.00532	.03175	0,00000	1,04423	.98924
17	191,25000	18,98684	-1,27502	-.25362	.00240	.11785	-.11411	-.00568	-.03043	0,00000	.93444	.98851
18	202,50000	18,98684	-1,20104	-.49749	.00240	.02734	.18211	-.00609	-.08742	0,00000	.82315	.98748
19	213,75000	18,98684	-1,08091	-.72224	.00237	-.07004	.19194	-.00653	-.12567	0,00000	.74577	.98678
20	225,00000	18,98684	-.91924	-.91924	.00236	-.15498	.15498	-.00700	-.14430	0,00000	.70860	.98544
21	236,25000	18,98684	-.72224	1,08091	.00233	-.21339	.08446	-.00746	-.14044	0,00000	.70679	.98491
22	247,50000	18,98684	-.49749	1,20104	.00205	-.23440	-.00445	-.00741	-.12944	0,00000	.71774	.98401
23	258,75000	18,98684	-.25362	1,27502	.00216	-.22095	-.09660	-.00632	-.10104	0,00000	.79560	.98318
24	270,00000	18,98684	.00000	-1,30000	.00234	-.16949	-.17544	-.00667	-.06304	0,00000	.72407	.98245
25	281,25000	18,98684	.25362	-1,27502	.00248	-.09147	-.22854	-.00847	-.02137	0,00000	.94677	.98145
26	292,50000	18,98684	.49749	-1,20104	.00459	.00193	-.24732	-.00919	.01666	0,00000	1,03371	.98141
27	303,75000	18,98684	.72224	-1,08091	.00466	.04575	-.22849	-.00932	.04345	0,00000	1,08790	.98114
28	315,00000	18,98684	.91924	-.41924	.00468	.17544	-.17544	-.00937	.05312	0,00000	1,10744	.98105
29	326,25000	18,98684	1,08091	-.72224	.00466	.22849	-.09575	-.00932	.04345	0,00000	1,08790	.98114

Figure 10.- Continued.

30	337.50000	1A.946d4	1.20104	-0.49749	0.00450	0.24732	-0.00193	-0.00919	0.01666	0.00000	1.03371	.98141
31	344.75000	1A.946d4	1.27502	-0.25362	0.00000	0.22854	0.09147	-0.00897	-0.02137	0.00000	.95677	.98145
32	349.00000	1A.946d4	1.30000	0.00000	0.00000	0.17544	0.16969	-0.00867	-0.06304	0.00000	.87247	.98245

TOTAL NUMBER OF PRESSURE POINTS JCPT= 320

POINT COORDINATES AND PERTURBATION VELOCITIES CALCULATED BY PROGRAM VPAT2DR VPAT4L

IC	XCP	YCP	ZCP	VVEL(IC)	WVEL(IC)
1	21.05100	1.53100	0.00000	0.21094E-02	-0.70848E-02
2	22.18700	1.53100	0.00000	0.27017E-02	-0.73904E-02
3	23.34200	1.53100	0.00000	0.23375E-02	-0.77102E-02
4	21.21600	1.99870	0.00000	0.40063E-02	-0.404570E-02
5	22.28100	1.99870	0.00000	0.41696E-02	-0.46394E-02
6	23.34700	1.99870	0.00000	0.43302E-02	-0.48259E-02
7	21.40000	2.46640	0.00000	0.43172E-02	-0.26581E-02
8	22.37600	2.46640	0.00000	0.44995E-02	-0.27581E-02
9	23.35100	2.46640	0.00000	0.46627E-02	-0.28607E-02
10	21.58500	2.93400	0.00000	0.41108E-02	-0.14995E-02
11	22.47000	2.93400	0.00000	0.42595E-02	-0.15510E-02
12	23.35600	2.93400	0.00000	0.44001E-02	-0.16042E-02
13	21.76900	3.40160	0.00000	0.47321E-02	-0.76388E-03
14	22.56500	3.40160	0.00000	0.38456E-02	-0.78743E-03
15	23.36000	3.40160	0.00000	0.39599E-02	-0.81257E-03
16	21.03100	-1.53100	0.00000	-0.76740E-01	-0.17028E+00
17	22.18700	-1.53100	0.00000	-0.76729E-01	-0.17591E+00
18	23.34200	-1.53100	0.00000	-0.75708E-01	-0.18067E+00
19	21.21600	-1.99870	0.00000	-0.13321E+00	-0.38546E-01
20	22.28100	-1.99870	0.00000	-0.13885E+00	-0.42546E-01
21	23.34700	-1.99870	0.00000	-0.14371E+00	-0.47503E-01
22	21.40000	-2.46640	0.00000	-0.76287E-01	-0.33042E-01
23	22.37600	-2.46640	0.00000	-0.80075E-01	-0.30808E-01
24	23.35100	-2.46640	0.00000	-0.84175E-01	-0.35741E-01
25	21.58500	-2.93400	0.00000	-0.32977E-01	-0.36668E-01
26	22.47000	-2.93400	0.00000	-0.34252E-01	-0.37988E-01
27	23.35600	-2.93400	0.00000	-0.35706E-01	-0.39482E-01
28	21.76900	-3.40160	0.00000	-0.14196E-01	-0.27926E-01
29	22.56500	-3.40160	0.00000	-0.14621E-01	-0.28902E-01
30	23.36000	-3.40160	0.00000	-0.15118E-01	-0.29897E-01
31	21.05100	0.00000	1.53100	-0.17026E+00	-0.76740E-01
32	22.18700	0.00000	1.53100	-0.17591E+00	-0.78724E-01
33	23.34200	0.00000	1.53100	-0.18067E+00	-0.75708E-01
34	21.21600	0.00000	1.99870	-0.38546E-01	-0.13321E+00
35	22.28100	0.00000	1.99870	-0.42546E-01	-0.13885E+00
36	23.34700	0.00000	1.99870	-0.47503E-01	-0.14371E+00
37	21.40000	0.00000	2.46640	-0.33042E-01	-0.76287E-01
38	22.37600	0.00000	2.46640	-0.30808E-01	-0.80075E-01
39	23.35100	0.00000	2.46640	-0.35741E-01	-0.84175E-01
40	21.58500	0.00000	2.93400	-0.36668E-01	-0.32977E-01
41	22.47000	0.00000	2.93400	-0.37988E-01	-0.34252E-01
42	23.35600	0.00000	2.93400	-0.39482E-01	-0.35706E-01
43	21.76900	0.00000	3.40160	-0.27926E-01	-0.14196E-01
44	22.56500	0.00000	3.40160	-0.28902E-01	-0.14621E-01
45	23.36000	0.00000	3.40160	-0.29897E-01	-0.15118E-01
46	21.03100	0.00000	-1.53100	-0.76740E-02	-0.21494E-02

Figure 10.- Continued.



47	22,14700	-.00000	-1,53100	.73004F-02	-.22417E-02
48	23,14700	-.00000	-1,53100	.77102F-02	-.23375E-02
49	21,21600	-.00000	-1,99070	.44570F-02	-.40063E-02
50	22,24100	-.00000	-1,99070	.46304F-02	-.41496E-02
51	23,14700	-.00000	-1,99070	.48254F-02	-.43342E-02
52	21,40000	-.00000	-2,46040	.26541E-02	-.43372E-02
53	22,37600	-.00000	-2,46040	.27541E-02	-.44495E-02
54	23,15100	-.00000	-2,46040	.28607E-02	-.44427E-02
55	21,54500	-.00000	-2,93400	.14995E-02	-.41194E-02
56	22,47000	-.00000	-2,93400	.15510E-02	-.42595E-02
57	23,15500	-.00000	-2,93400	.16042E-02	-.44001E-02
58	21,74900	-.00000	-3,40160	.76144E-03	-.37321E-02
59	22,56500	-.00000	-3,40160	.78743E-03	-.34456E-02
60	23,36000	-.00000	-3,40160	.81237E-03	-.39599E-02
61	20,94000	1,25050	.24874	.20095E-02	-.12229E-01
62	20,94000	1,06010	.70836	.12910E-01	-.20885E-01
63	20,94000	.70836	1,06010	.42443E-01	-.31116E-01
64	20,94000	.24874	1,25050	.12846E+00	-.32280E-01
65	20,94000	-.24874	1,25050	.32964E+00	.54137E-01
66	20,94000	-.70836	1,06010	.16614E+00	.13512E+00
67	20,94000	-1,06010	.70836	-.13512E+00	.16618E+00
68	20,94000	-1,25050	.24874	-.55337E-01	.32964E+00
69	20,94000	-1,25050	-.24874	.32246E-01	.12846E+00
70	20,94000	-1,06010	-.70836	.31116E-01	.42443E-01
71	20,94000	-.70836	-1,06010	.20885E-01	.12914E-01
72	20,94000	-.24874	-1,25050	.12229E-01	.20095E-02
73	20,94000	.24874	-1,25050	.54242E-02	.14995E-02
74	20,94000	.70836	-1,06010	.13956E-02	.11524E-02
75	20,94000	1,06010	-.70836	-.11524E-02	.13956E-02
76	20,94000	1,25050	-.24874	-.14995E-02	.54242E-02
77	22,14000	1,25050	.24874	.20095E-02	-.12770E-01
78	22,14000	1,06010	.70836	.13446E-01	-.21794E-01
79	22,14000	.70836	1,06010	.44444E-01	-.32424E-01
80	22,14000	.24874	1,25050	.13321E+00	-.33330E-01
81	22,14000	-.24874	1,25050	.32944E+00	.56140E-01
82	22,14000	-.70836	1,06010	.15930E+00	.12975E+00
83	22,14000	-1,06010	.70836	-.12975E+00	.15934E+00
84	22,14000	-1,25050	.24874	-.56140E-01	.32944E+00
85	22,14000	-1,25050	-.24874	.33330E-01	.13321E+00
86	22,14000	-1,06010	-.70836	.32424E-01	.44444E-01
87	22,14000	-.70836	-1,06010	.21794E-01	.13446E-01
88	22,14000	-.24874	-1,25050	.12770E-01	.20095E-02
89	22,14000	.24874	-1,25050	.40844E-02	.14706E-02
90	22,14000	.70836	-1,06010	.14575E-02	.12035E-02
91	22,14000	1,06010	-.70836	-.12035E-02	.14575E-02
92	22,14000	1,25050	-.24874	-.14706E-02	.40844E-02
93	23,34000	1,25050	.24874	.21724E-02	-.13446E-01
94	23,34000	1,06010	.70836	.14077E-01	-.22751E-01
95	23,34000	.70836	1,06010	.46275E-01	-.33741E-01
96	23,34000	.24874	1,25050	.13737E+00	-.50239E-01
97	23,34000	-.24874	1,25050	.32742E+00	.56877E-01
98	23,34000	-.70836	1,06010	.15241E+00	.12413E+00
99	23,34000	-1,06010	.70836	-.12413E+00	.15241E+00
100	23,34000	-1,25050	.24874	-.56877E-01	.32742E+00
101	23,34000	-1,25050	-.24874	.40240E-01	.13737E+00
102	23,34000	-1,06010	-.70836	.33741E-01	.46275E-01
103	23,34000	-.70836	-1,06010	.22751E-01	.14077E-01
104	23,34000	-.24874	-1,25050	.13340E-01	.21724E-02
105	23,34000	.24874	-1,25050	.63609E-02	.15364E-02

Figure 10.- Continued.

106	23.34000	.70836	-1.06010	.15235E-02	.12579E-02
107	23.34000	1.06010	-.70836	-.12579E-02	-.15235E-02
108	23.34000	1.25050	-.24474	-.15340E-02	-.63804E-02

CONTROL POINT COORDINATES FOR 3 CHORDWISE BY 5 SPANWISE PANELS ON WING 1 OR R, 5 SPANWISE ON WING 2 OR L  
AND 5 SPANWISE PANELS ON WING 3 OR U, 5 SPANWISE ON WING 4 OR D

J	X(J)	Y(J)	Z(J)	RU(J)	RV(J)	RW(J)	VVRTX	WVRTX
1	1.23112	1.53096	0.00000	.30415E-02	.12408E+00	.12749E+00	0.	0.
2	2.38667	1.53096	0.00000	.25619E-02	.12617E+00	.12768E+00	0.	0.
3	3.54222	1.53096	0.00000	.22035E-02	.12622E+00	.12755E+00	0.	0.
4	1.41565	1.99870	0.00000	.30173E-02	.73266E-01	.75357E-01	0.	0.
5	2.48119	1.99870	0.00000	.25674E-02	.73453E-01	.75200E-01	0.	0.
6	3.54672	1.99870	0.00000	.22281E-02	.73541E-01	.75098E-01	0.	0.
7	1.60017	2.46640	0.00000	.30518E-02	.47405E-01	.49768E-01	0.	0.
8	2.57570	2.46640	0.00000	.26235E-02	.47450E-01	.49633E-01	0.	0.
9	3.55122	2.46640	0.00000	.22924E-02	.47827E-01	.49541E-01	0.	0.
10	1.78466	2.93403	0.00000	.31062E-02	.32808E-01	.35417E-01	0.	0.
11	2.67019	2.93403	0.00000	.26945E-02	.33091E-01	.35293E-01	0.	0.
12	3.55572	2.93403	0.00000	.23729E-02	.33299E-01	.35206E-01	0.	0.
13	1.96912	3.40158	0.00000	.32017E-02	.24701E-01	.26577E-01	0.	0.
14	2.76467	3.40158	0.00000	.28029E-02	.24011E-01	.26441E-01	0.	0.
15	3.56022	3.40158	0.00000	.24715E-02	.24266E-01	.26377E-01	0.	0.
16	1.23112	-1.53096	0.00000	.23345E-02	.12635E+00	.12749E+00	0.	0.
17	2.38667	-1.53096	0.00000	.21254E-02	.12638E+00	.12768E+00	0.	0.
18	3.54222	-1.53096	0.00000	.19174E-02	.12640E+00	.12755E+00	0.	0.
19	1.41565	-1.99870	0.00000	.22883E-02	.73972E-01	.75357E-01	0.	0.
20	2.48119	-1.99870	0.00000	.21091E-02	.74042E-01	.75200E-01	0.	0.
21	3.54672	-1.99870	0.00000	.19229E-02	.74077E-01	.75098E-01	0.	0.
22	1.60017	-2.46640	0.00000	.21980E-02	.48453E-01	.49768E-01	0.	0.
23	2.57570	-2.46640	0.00000	.20524E-02	.48538E-01	.49633E-01	0.	0.
24	3.55122	-2.46640	0.00000	.18469E-02	.48588E-01	.49541E-01	0.	0.
25	1.78466	-2.93403	0.00000	.21408E-02	.34196E-01	.35417E-01	0.	0.
26	2.67019	-2.93403	0.00000	.20174E-02	.34274E-01	.35293E-01	0.	0.
27	3.55572	-2.93403	0.00000	.18823E-02	.34317E-01	.35206E-01	0.	0.
28	1.96912	-3.40158	0.00000	.20349E-02	.25363E-01	.26577E-01	0.	0.
29	2.76467	-3.40158	0.00000	.19547E-02	.25464E-01	.26441E-01	0.	0.
30	3.56022	-3.40158	0.00000	.18804E-02	.25558E-01	.26377E-01	0.	0.
31	1.23112	0.00000	1.53096	.23353E-02	-.12789E+00	-.12645E+00	0.	0.
32	2.38667	0.00000	1.53096	.21254E-02	-.12768E+00	-.12638E+00	0.	0.
33	3.54222	0.00000	1.53096	.19174E-02	-.12755E+00	-.12640E+00	0.	0.
34	1.41565	0.00000	1.99870	.22883E-02	-.75357E-01	-.73972E-01	0.	0.
35	2.48119	0.00000	1.99870	.21091E-02	-.75200E-01	-.74042E-01	0.	0.
36	3.54672	0.00000	1.99870	.19229E-02	-.75098E-01	-.74077E-01	0.	0.
37	1.60017	0.00000	2.46640	.21980E-02	-.48453E-01	-.49768E-01	0.	0.
38	2.57570	0.00000	2.46640	.20524E-02	-.48538E-01	-.49633E-01	0.	0.
39	3.55122	0.00000	2.46640	.18469E-02	-.48588E-01	-.49541E-01	0.	0.
40	1.78466	0.00000	2.93403	.21408E-02	-.34196E-01	-.35417E-01	0.	0.
41	2.67019	0.00000	2.93403	.20174E-02	-.34274E-01	-.35293E-01	0.	0.
42	3.55572	0.00000	2.93403	.18823E-02	-.34317E-01	-.35206E-01	0.	0.
43	1.96912	0.00000	3.40158	.20349E-02	-.25363E-01	-.26577E-01	0.	0.
44	2.76467	0.00000	3.40158	.19547E-02	-.25464E-01	-.26441E-01	0.	0.
45	3.56022	0.00000	3.40158	.18804E-02	-.25558E-01	-.26377E-01	0.	0.
46	1.23112	0.00000	-1.53096	.30415E-02	-.12789E+00	-.12645E+00	0.	0.
47	2.38667	0.00000	-1.53096	.25619E-02	-.12617E+00	-.12768E+00	0.	0.
48	3.54222	0.00000	-1.53096	.22035E-02	-.12622E+00	-.12755E+00	0.	0.
49	1.41565	0.00000	-1.99870	.30173E-02	-.75357E-01	-.75200E-01	0.	0.
50	2.48119	0.00000	-1.99870	.25674E-02	-.75200E-01	-.74453E-01	0.	0.

Figure 10.- Continued.

51	1,54672	0,00000	=1,99870	,22221E-02	=,75098E-01	=,74581E-01	0,	0,
52	1,60017	0,00000	=2,46640	,30518E-02	=,49764E-01	=,47405E-01	0,	0,
53	2,57570	0,00000	=2,46640	,26235E-02	=,49633E-01	=,47650E-01	0,	0,
54	3,55122	0,00000	=2,46640	,22924E-02	=,49541E-01	=,47827E-01	0,	0,
55	1,78466	0,00000	=2,93443	,31062E-02	=,35417E-01	=,32804E-01	0,	0,
56	2,67019	0,00000	=2,93403	,26945E-02	=,35293E-01	=,33091E-01	0,	0,
57	3,55572	0,00000	=2,93403	,23729E-02	=,35206E-01	=,33299E-01	0,	0,
58	1,96912	0,00000	=3,40158	,32017E-02	=,26577E-01	=,23701E-01	0,	0,
59	2,76467	0,00000	=3,40158	,28029E-02	=,26461E-01	=,24011E-01	0,	0,
60	3,56022	0,00000	=3,40158	,24715E-02	=,26477E-01	=,24266E-01	0,	0,

## CONTROL POINT COORDINATES FOR HTP-3 (WING FRAME)

J	X(J)	Y(J)	Z(J)	THU(J)	THV(J)	THW(J)
61	1,14000	1,25052	,24874	=,13891E-02	=,18221E-01	,34655E-02
62	1,14000	1,06014	,70836	=,15717E-01	=,88792E-02	,20553E-01
63	1,14000	,70836	1,06014	=,15717E-01	,20553E-01	=,88792E-02
64	1,14000	,24874	1,25052	=,13891E-02	,34655E-02	=,18221E-01
65	1,14000	=,24874	1,25052	=,13891E-02	=,34655E-02	=,18221E-01
66	1,14000	=,70836	1,06014	=,15717E-01	=,20553E-01	=,88792E-02
67	1,14000	=1,06014	,70836	=,15717E-01	=,88792E-02	,20553E-01
68	1,14000	=1,25052	,24874	=,13891E-02	=,18221E-01	,34655E-02
69	1,14000	=1,25052	=,24874	=,13891E-02	=,18221E-01	=,34655E-02
70	1,14000	=1,06014	=,70836	=,15717E-01	=,88792E-02	=,20553E-01
71	1,14000	=,70836	=1,06014	=,15717E-01	=,20553E-01	=,88792E-02
72	1,14000	=,24874	=1,25052	=,13891E-02	=,34655E-02	=,18221E-01
73	1,14000	,24874	=1,25052	=,13891E-02	,34655E-02	=,18221E-01
74	1,14000	,70836	=1,06014	=,15717E-01	=,20553E-01	=,88792E-02
75	1,14000	=,06014	=,70836	=,15717E-01	=,88792E-02	=,20553E-01
76	1,14000	1,25052	=,24874	=,13891E-02	=,18221E-01	=,34655E-02
77	2,34000	1,25052	=,24874	=,10617E-01	=,85805E-02	=,48355E-02
78	2,34000	1,06014	,70836	=,22211E-01	=,16042E-01	=,68216E-02
79	2,34000	,70836	1,06014	=,22211E-01	=,16042E-01	=,68216E-02
80	2,34000	=,24874	1,25052	=,10617E-01	=,85805E-02	=,48355E-02
81	2,34000	=,24874	1,25052	=,10617E-01	=,85805E-02	=,48355E-02
82	2,34000	=,70836	1,06014	=,22211E-01	=,16042E-01	=,68216E-02
83	2,34000	=1,06014	,70836	=,22211E-01	=,16042E-01	=,68216E-02
84	2,34000	=1,25052	,24874	=,10617E-01	=,85805E-02	=,48355E-02
85	2,34000	=1,25052	=,24874	=,10617E-01	=,85805E-02	=,48355E-02
86	2,34000	=1,06014	=,70836	=,22211E-01	=,16042E-01	=,68216E-02
87	2,34000	=,70836	=1,06014	=,22211E-01	=,16042E-01	=,68216E-02
88	2,34000	=,24874	=1,25052	=,10617E-01	=,85805E-02	=,48355E-02
89	2,34000	,24874	=1,25052	=,10617E-01	=,85805E-02	=,48355E-02
90	2,34000	,70836	=1,06014	=,22211E-01	=,16042E-01	=,68216E-02
91	2,34000	1,06014	=,70836	=,22211E-01	=,16042E-01	=,68216E-02
92	2,34000	1,25052	=,24874	=,10617E-01	=,85805E-02	=,48355E-02
93	3,54000	1,25052	,24874	,20323E-01	,26782E-01	=,54507E-01
94	3,54000	1,06014	,70836	=,22241E-01	,11295E-01	,68311E-02
95	3,54000	,70836	1,06014	=,22241E-01	,11295E-01	,68311E-02
96	3,54000	,24874	1,25052	,20323E-01	=,54507E-01	,26782E-01
97	3,54000	=,24874	1,25052	,20323E-01	=,54507E-01	,26782E-01
98	3,54000	=,70836	1,06014	=,22241E-01	=,11295E-01	,68311E-02
99	3,54000	=1,06014	,70836	=,22241E-01	=,11295E-01	,68311E-02
100	3,54000	=1,25052	,24874	,20323E-01	=,26782E-01	=,54507E-01
101	3,54000	=1,25052	=,24874	,20323E-01	=,26782E-01	=,54507E-01
102	3,54000	=1,06014	=,70836	=,22241E-01	=,11295E-01	=,68311E-02
103	3,54000	=,70836	=1,06014	=,22241E-01	=,11295E-01	=,68311E-02

Figure 10.- Continued.

104	3.54000	-.24874	-1.25052	.20123E-01	.54507E-01	-.24782E-01
105	3.54000	.24874	-1.25052	.20123E-01	-.54507E-01	-.24782E-01
106	3.54000	.70834	-1.06014	-.22241E-01	.68311E-02	-.11295E-01
107	3.54000	1.06014	-.70834	-.22241E-01	.11295E-01	-.68311E-02
108	3.54000	1.25052	-.24874	.20123E-01	.54507E-01	-.24782E-01

# LOADING INFORMATION

MACH NUMBER	=	.17000E+01
ANGLE OF ATTACK	=	10.000 DEGREES
SIDE SLIP ANGLE	=	10.000 DEGREES
WING AREA	=	13.68666
REFERENCE AREA	=	9.30029
REFERENCE LENGTH	=	2.69000
EXPOSED WING SPAN	=	0.68000
MOMENT CENTER X	=	10.50000
MOMENT CENTER Z	=	0.00000

## WING TYPE LOADING PRESSURE

DEFL. ANGLE DEG.	TOTAL	FIN 1 OR R	FIN 2 OR L	FIN 3 OR U	FIN 4 OR D	INTERP. SHELL
CTMD	= .53914E+01	0.00000	0.00000	0.00000	0.00000	
CZ	= .14450E+01	.14774E+01	.12184E+01	.12184E+01	.14774E+01	.22517E+00
CY	= -.14450E+01	.66234E+00	.55744E+00	.55744E+00	.66234E+00	-.22517E+00
CM	= -.14547E+01	-.65426E+00	-.54950E+00	-.54950E+00	-.65426E+00	-.25492E+00
CLN	= .14547E+01	0.	0.	.54950E+00	.65426E+00	.25492E+00
CLI	= .14346E+13	-.57474E+00	.50518E+00	-.50518E+00	.57474E+00	.13507E+15

## FOLLOWING ARE IN WIND-AXIS SYSTEM

CL	= .14942E+01	.45743E+00	.34511E+00	.38511E+00	.45743E+00	.30849E+00
CY-IND	= .46164E-12	.46810E+00	.39419E+00	-.39419E+00	.46810E+00	.63505E-12
CU	= .44957E+00	.10049E+00	.44992E-01	.44992E-01	.10049E+00	.78202E-01
CU/CL+2	= .11345E+00					
CM-IND	= -.20429E+01	-.46263E+00	-.38455E+00	-.38455E+00	-.46263E+00	-.36052E+00
CL-IND	= -.61014E-12	-.30731E+00	.50072E+00	.50072E+00	.30731E+00	-.56044E-12

NOTE: L.E. OF LEAD PANEL IN FIRST CHORDWISE ROW IS SUPERSONIC

Figure 10.- Continued.

-----RIGHT JTAG-----

## SPANWISE DISTRIBUTIONS

I	Y/(H/2)	CN=C/(2*B)	CI=C/(2*B)	CVI=C/(2*B)	CVTOT=C/(2*B)	CS=C/(2*B)	CSINT	YBAR	GAMMAE(I)	GAMMA,LE/VINF	XLE
1	.65476	.19347	0.00000	0.00000	.00070	0.00000	0.00000	0.00000	-.90825	0.00000	.13334
2	.85415	.18840	0.00000	0.00000	.00259	0.00000	0.00000	0.00000	.02601	0.00000	.40340
3	1.05402	.17267	0.00000	0.00000	.00225	0.00000	0.00000	0.00000	.07359	0.00000	.67342
4	1.25386	.14562	0.00000	0.00000	.00201	0.00000	0.00000	0.00000	.12655	0.00000	.94341
5	1.45367	.10212	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.20348	0.00000	1.21335
6	1.55556	0.00000							.47841		

SUMFY = 0.  
 SUMFY1 = 0.  
 SUMFY2 = .62235E-02  
 SUMFT2 = .25695E-01

## SIDE EDGE DISTRIBUTION

JTID	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(0.1TIPCHORD)	GAMMA,SE /VINF	YBAR	XSE
1	1	.33333	.00311	.00055	3.64000	1.55100
2	2	.66667	.03528	.00681	3.64000	2.10067
3	3	1.00000	.04568	.01491	3.64000	2.45033

\*\*\*\*\*E. FIN VORTEX INFO\*\*\*\*\*

1VBT GAMMA/VINF Y,C.G.  
 1 .90779 3.23687

----- LEFT WING-----

# SPANWISE DISTRIBUTIONS

I	Y/(B/2)	CN*C/(2*B)	CT*C/(2*B)	CY1*C/(2*B)	CYTOT*C/(2*B)	CS*C/(2*B)	CSINT	YBAR	GAMNET(I)	GAMMA,LF/VINF	XLE
7	-.65424	.12209	0.00000	0.00000	-.00401	0.00000	0.00000	0.00000	.57449	0.00000	.13334
8	-.85415	.14651	0.00000	0.00000	-.00178	0.00000	0.00000	0.00000	.11159	0.00000	.40340
9	-1.05402	.15930	0.00000	0.00000	-.00165	0.00000	0.00000	0.00000	.05999	0.00000	.67342
10	-1.25386	.14379	0.00000	0.00000	-.00351	0.00000	0.00000	0.00000	-.07257	0.00000	.94341
11	-1.45367	.10337	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.18919	0.00000	1.21335
12	-1.55556	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.48431		

SUMFX = 0.  
 SUMFY1 = 0.  
 SUMFY2 = -.61037E-02  
 SUMF72 = -.32174E-01

# SIDE EDGE DISTRIBUTION

JTID	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(Q*TIPCHORD)	GAMMA,SE /VINF	YBAR	XSE
1	1	.33333	-.00495	-.00088	-3.64000	1.35100
2	2	.66667	-.00491	-.00920	-3.64000	2.10067
3	3	1.00000	-.00446	-.01797	-3.64000	2.85033

\*\*\*\*T.E. FIN VORTEX INFO\*\*\*\*

IVRT GAMMA/VINF Y/C.G.

2 .17134 -1.93153  
 3 -.74554 -3.43010

Figure 10.- Continued.

## SPANISH DISTRIBUTIONS

I	Z/(R/2)	C4=C/(2*H)	C1=C/(2*H)	C21=C/(2*H)	C2707=C/(2*H)	C3=C/(2*H)	CSINT	ZHAR	GAMMAET(1)	GAMMA,LE/VINF	XLE
13	.85426	.12269	0.00000	0.00000	.00401	0.00000	0.00000	0.00000	-.57409	0.00000	.13330
14	.85015	.10451	0.00000	0.00000	-.00178	0.00000	0.00000	0.00000	-.11159	0.00000	.40340
15	1.05402	.15930	0.00000	0.00000	.00145	0.00000	0.00000	0.00000	-.05909	0.00000	.67347
16	1.25306	.14479	0.00000	0.00000	.00351	0.00000	0.00000	0.00000	.07257	0.00000	.94341
17	1.45367	.10337	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.14919	0.00000	1.21335
18	1.55556	0.00000							.04431		

SUMF1 = 0.  
 SUMF2 = 0.  
 SUMF22 = .01017E-02  
 SUMF23 = .32174E-01

## SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(UNITCHORD)	GAMMA,SE /VINF	ZHAR	XSE
1	4	.55353	.00495	.00000	3.64000	1.35100
2	5	.06667	.04691	.00920	3.64000	2.10067
3	6	1.00000	.04906	.01797	3.64000	2.85033

\*\*\*\*T.F. FIN VORTEX INFO\*\*\*\*

TURT	GAMMA/VINF	Z.C.G.
4	-.17134	1.93153
5	.74554	3.43010

Figure 10.- Continued.

SP40-15E DISTRIBUTIONS

I	Z/(H/2)	CN+C/(2*B)	CT+C/(2*B)	CZ1+C/(2*B)	CZTOT+C/(2*B)	CS+C/(2*B)	CSINT	ZHAR	GAMNET(1)	GAMMA,LE/VINF	XLF
19	-.65426	.19397	0.00000	0.00000	-.00070	0.00000	0.00000	0.00000	.90825	0.00000	.13330
20	-.85415	.18840	0.00000	0.00000	-.00259	0.00000	0.00000	0.00000	-.02601	0.00000	.40340
21	-1.05402	.17207	0.00000	0.00000	-.00225	0.00000	0.00000	0.00000	-.07359	0.00000	.67342
22	-1.25386	.14562	0.00000	0.00000	-.00201	0.00000	0.00000	0.00000	-.12655	0.00000	.94341
23	-1.45367	.10212	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.20368	0.00000	1.21345
24	-1.55556	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.47841		

SUMFY = 0.  
 SUMFZ1 = 0.  
 SUMFZ2 = -.02235E+02  
 SUMFT2 = -.20694E+01

SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE / (0.5 * TIPCHORD)	SUCTION FORCE PER UNIT LENGTH / (0.5 * TIPCHORD)	GAMMA, SE / VINF	ZHAR	XSE
1	7	.33333	-.00311	-.00055	-3.64000	1.35100
2	8	.66667	-.03528	-.00681	-3.64000	2.10067
3	9	1.00000	-.04568	-.01491	-3.64000	2.85033

\*\*\*T.E. FIN VORTEX INFO\*\*\*

IVRT GAMMA/VINF Z.C.G.

h = -.90779 -3.23687

VELOCITIES AND BERNOULLI PRESSURES AT CONTROL POINTS IMMEDIATELY ABOVE AND BELOW HORIZONTAL WING SURFACE

J	X(J)	Y(J)	Z(J)	UTOTA	VTOTA	WTOTA	PRESSA	UTOTB	VTOTB	WTOTB	PRESSB
1	1.251118	1.530959	0.000000	.146955	-.005464	-.173650	-.226794	.182872	.140985	-.173650	.498202
2	2.386670	1.530959	0.000000	.124987	.070735	-.173650	-.178168	.116691	.167834	-.173650	.331516
3	3.542222	1.530959	0.000000	.102488	.159554	-.173650	-.212304	-.071752	.200785	-.032650	.196546
4	1.015454	1.998701	0.000000	.248685	.131702	-.173650	-.374805	.107871	.074156	-.173650	.295550
5	2.481188	1.998701	0.000000	.129541	.026553	-.173650	-.193772	-.126751	.125200	-.173650	.352481

1.015454 1.998701 0.000000



6	3.546723	1.998701	0.000000	.140537	.112974	-.314650	-.246240	-.050542	.154275	-.052650	.149361
7	1.600170	2.466397	0.000000	.174346	-.053659	-.173650	-.270427	-.176446	.149078	-.173650	.402765
8	2.475697	2.466397	0.000000	.146559	-.003287	-.173650	-.251365	-.115465	.111466	-.173650	.323032
9	1.551224	2.466397	0.000000	.239154	.092444	-.314650	-.338494	.042493	.130264	-.032650	-.044914
10	1.784662	2.934030	0.000000	.174706	-.024407	-.173650	-.274891	-.157138	.147316	-.173650	.432244
11	2.670193	2.934030	0.000000	.197168	-.051134	-.173650	-.303190	-.083959	.057072	-.173650	.233414
12	3.555723	2.934030	0.000000	.118982	.031854	-.314650	-.190419	-.034274	.041348	-.032650	.099520
13	1.969121	3.401580	0.000000	.125277	.046599	-.173650	-.143220	-.172306	.218409	-.173650	.467925
14	2.764672	3.401580	0.000000	.090547	.022494	-.173650	-.151423	-.096299	.095385	-.173650	.277790
15	3.560222	3.401580	0.000000	.212661	-.059434	-.314650	-.332044	.097731	-.037715	-.032650	-.175148
16	1.231118	-1.530959	0.000000	.070132	.140081	-.173650	-.076948	-.103380	.040703	-.173650	.274053
17	2.386670	-1.530959	0.000000	.095711	.090433	-.173650	-.127488	-.096230	.016555	-.173650	.247741
18	3.542222	-1.530959	0.000000	.190549	.073434	-.314650	-.244295	.058845	.048087	-.032650	-.046620
19	1.415654	-1.998701	0.000000	.206874	.128113	-.173650	-.289425	-.047508	-.027466	-.173650	.151471
20	2.481188	-1.998701	0.000000	.124550	-.002499	-.173650	-.192702	-.096286	-.047695	-.173650	.191176
21	3.546723	-1.998701	0.000000	.276749	-.032055	-.314650	-.319963	.053188	-.041612	-.032650	-.110478
22	1.600170	-2.466397	0.000000	.170000	.055568	-.173650	-.270981	-.174197	-.143171	-.173650	.323006
23	2.575697	-2.466397	0.000000	.154059	.015503	-.173650	-.232395	-.100169	-.082349	-.173650	.203289
24	3.551224	-2.466397	0.000000	.228727	-.071603	-.314650	-.351000	.062395	-.143614	-.032650	-.143375
25	1.784662	-2.934030	0.000000	.192359	.073174	-.173650	-.275643	-.172682	-.147580	-.173650	.324580
26	2.670193	-2.934030	0.000000	.190175	.088538	-.173650	-.271237	-.073527	-.012941	-.173650	.182647
27	3.555723	-2.934030	0.000000	.119597	.114754	-.314650	-.194094	-.012214	-.006614	-.032650	.032195
28	1.969121	-3.401580	0.000000	.141591	.002093	-.173650	-.217201	-.190954	-.149902	-.173650	.315261
29	2.764672	-3.401580	0.000000	.086720	.014855	-.173650	-.126856	-.096168	-.055539	-.173650	.211039
30	3.560222	-3.401580	0.000000	.203488	.100104	-.314650	-.298294	.110529	.082141	-.032650	-.168646

VELOCITIES AND HEMPHILL PRESSURES AT CONTROL POINTS IMMEDIATELY TO RIGHT AND LEFT OF VERTICAL WING SURFACE

J	X(J)	Y(J)	Z(J)	UTOTR	VTOTR	WTOTR	PRESSR	UTOTL	VTOTL	WTOTL	PRESSL
31	1.231118	0.000000	1.530959	-.103380	.173650	-.040703	.274053	.070132	.173650	-.147081	-.076948
32	2.386670	0.000000	1.530959	-.096230	.173650	-.016555	.247741	.045711	.173650	-.090433	-.127488
33	3.542222	0.000000	1.530959	-.058845	.144650	-.048687	-.046620	.190549	.032650	-.073434	-.284295
34	1.415654	0.000000	1.998701	-.062598	.173650	.027466	.151471	.206874	.173650	-.128113	-.269425
35	2.481188	0.000000	1.998701	-.094286	.173650	.087695	.191176	.124550	.173650	.002699	-.192702
36	3.546723	0.000000	1.998701	-.053188	.314650	.061612	-.110478	.206749	.032650	.032055	-.319963
37	1.600170	0.000000	2.466397	-.174197	.173650	.143171	.323006	.170030	.173650	-.055568	-.247981
38	2.575697	0.000000	2.466397	-.100169	.173650	.082349	.203289	.154059	.173650	-.015503	-.232395
39	3.551224	0.000000	2.466397	-.062395	.314650	.103614	-.143375	.228727	.032650	.071603	-.351000
40	1.784662	0.000000	2.934030	-.172682	.173650	.147580	.324580	.192359	.173650	-.073176	-.275643
41	2.670193	0.000000	2.934030	-.073527	.173650	.012961	.182647	.190175	.173650	-.088538	-.271239
42	3.555723	0.000000	2.934030	-.012214	.314650	.006614	.032195	.119597	.032650	-.012754	-.194094
43	1.969121	0.000000	3.401580	-.140954	.173650	.189902	.151521	.141591	.173650	-.002093	-.217201
44	2.764672	0.000000	3.401580	-.096168	.173650	.055539	.211039	.086720	.173650	-.014855	-.126856
45	3.560222	0.000000	3.401580	-.110529	.144650	-.042141	-.146646	.203488	.032650	-.100104	-.298294
46	1.231118	0.000000	-1.530959	-.182472	.173650	-.184985	.146495	.095495	.173650	.005464	-.226794
47	2.386670	0.000000	-1.530959	-.116491	.173650	-.167834	.331514	.124947	.173650	-.074735	-.178168
48	3.542222	0.000000	-1.530959	-.071752	.314650	-.200785	.176546	.142488	.032650	-.154554	-.212304
49	1.415654	0.000000	-1.998701	-.107471	.173650	-.074156	.294550	.208685	.173650	-.131702	-.374805
50	2.481188	0.000000	-1.998701	-.126751	.173650	-.125204	.352481	.124551	.173650	-.026553	-.193772
51	3.546723	0.000000	-1.998701	-.050542	.314650	-.154275	.149361	.146537	.032650	-.112974	-.244295
52	1.600170	0.000000	-2.466397	-.176446	.173650	-.169074	.442705	.174346	.173650	.033659	-.270427
53	2.575697	0.000000	-2.466397	-.115465	.173650	-.111466	.323032	.146549	.173650	-.001287	-.251365
54	3.551224	0.000000	-2.466397	-.042493	.314650	-.130264	-.044914	.130264	.032650	.042494	-.338494
55	1.784662	0.000000	-2.934030	-.157138	.173650	-.167316	.432244	.178746	.173650	.026667	-.274891
56	2.670193	0.000000	-2.934030	-.083959	.173650	-.057072	.233414	.197168	.173650	.051134	-.303190
57	3.555723	0.000000	-2.934030	-.034274	.314650	-.041348	.099520	.118982	.032650	-.031854	-.190419

Figure 10.- Continued.

58	1.969121	0.000000	-3.401580	-0.172306	.173650	-.218409	.467925	.125277	.173450	-.046509	-.181220
59	2.764672	0.000000	-3.401580	-.098299	.173650	-.095385	.277790	.090547	.173650	-.022698	-.131423
60	1.560222	0.000000	-3.401580	.097731	.318650	.037715	-.175108	.212661	.032650	.059430	-.332048

PRESSURE LOADINGS AT CONTROL POINTS

J	X(J)	Y(J)	Z(J)	DELTP, LIN.	DELTP, HFRN.
1	1.231118	1.530959	0.000000	.659730	.724996
2	2.386670	1.530959	0.000000	.483756	.509680
3	3.542222	1.530959	0.000000	.428480	.408850
4	1.415654	1.998701	0.000000	.713112	.670455
5	2.481188	1.998701	0.000000	.512603	.546253
6	3.546723	1.998701	0.000000	.430237	.375601
7	1.600170	2.466397	0.000000	.702303	.753532
8	2.575697	2.466397	0.000000	.563049	.574397
9	3.551224	2.466397	0.000000	.392520	.293978
10	1.784662	2.934030	0.000000	.671770	.707175
11	2.670193	2.934030	0.000000	.562255	.537004
12	3.555723	2.934030	0.000000	.306512	.289938
13	1.969121	3.401580	0.000000	.695167	.651145
14	2.764672	3.401580	0.000000	.377692	.409213
15	3.560222	3.401580	0.000000	.229861	.154900
16	1.231118	-1.530959	0.000000	.347024	.351000
17	2.386670	-1.530959	0.000000	.343882	.375229
18	3.542222	-1.530959	0.000000	.283406	.197475
19	1.415654	-1.998701	0.000000	.538944	.441296
20	2.481188	-1.998701	0.000000	.441654	.383878
21	3.546723	-1.998701	0.000000	.307162	.209285
22	1.600170	-2.466397	0.000000	.684454	.570987
23	2.575697	-2.466397	0.000000	.408455	.435683
24	3.551224	-2.466397	0.000000	.337665	.207625
25	1.784662	-2.934030	0.000000	.730082	.600274
26	2.670193	-2.934030	0.000000	.527405	.453886
27	3.555723	-2.934030	0.000000	.263632	.226288
28	1.969121	-3.401580	0.000000	.665088	.532061
29	2.764672	-3.401580	0.000000	.365775	.337895
30	3.560222	-3.401580	0.000000	.186679	.129650
31	1.231118	0.000000	1.530959	.347024	.351000
32	2.386670	0.000000	1.530959	.383882	.375229
33	3.542222	0.000000	1.530959	.283406	.197475
34	1.415654	0.000000	1.998701	.538944	.441296
35	2.481188	0.000000	1.998701	.441654	.383878
36	3.546723	0.000000	1.998701	.307162	.209285
37	1.600170	0.000000	2.466397	.684454	.570987
38	2.575697	0.000000	2.466397	.408455	.435683
39	3.551224	0.000000	2.466397	.337665	.207625
40	1.784662	0.000000	2.934030	.730082	.600274
41	2.670193	0.000000	2.934030	.527405	.453886
42	3.555723	0.000000	2.934030	.263632	.226288
43	1.969121	0.000000	3.401580	.665088	.532061
44	2.764672	0.000000	3.401580	.365775	.337895
45	3.560222	0.000000	3.401580	.186679	.129650
46	1.231118	0.000000	-1.530959	.347024	.351000
47	2.386670	0.000000	-1.530959	.343756	.509680
48	3.542222	0.000000	-1.530959	.428480	.408850
49	1.415654	0.000000	-1.998701	.713112	.670355

Figure 10.- Continued.

50	2.481188	0.000000	-1.998701	.512603	.546253
51	3.546723	0.000000	-1.998701	.430237	.545401
52	1.800170	0.000000	-2.466397	.702303	.753532
53	2.575497	0.000000	-2.466397	.563049	.574397
54	3.551224	0.000000	-2.466397	.392520	.273979
55	1.784462	0.000000	-2.466397	.871770	.707175
56	2.670193	0.000000	-2.934030	.562245	.537000
57	3.555723	0.000000	-2.934030	.306512	.289938
58	1.969121	0.000000	-3.401580	.595167	.651145
59	2.764472	0.000000	-3.401580	.377692	.409213
60	3.560222	0.000000	-3.401580	.229861	.154400

## LOADING INFORMATION

MACH NUMBER = .17000E+01  
 ANGLE OF ATTACK = 10.000 DEGREES  
 SIDE SLIP ANGLE = 10.000 DEGREES  
 WING AREA = 13.68666  
 REFERENCE AREA = 5.30929  
 REFERENCE LENGTH = 2.69000  
 EXPOSED WING SPAN = 4.68000  
 MOMENT CENTER: X = 19.50000  
 Z = 0.00000

## BERNOULLI TYPE LOADING PRESSURE

REFL. ANGLE DEG.	TOTAL	FIN 1 OR R	FIN 2 OR L	FIN 3 OR U	FIN 4 OR D	INTERP. SMALL
CTR	.49666E+01	.18912E+01	.99211E+02	.99211E+02	.14912E+01	
CZ	.13535E+01	.66290E+00	.46540E+00	0.	0.	.22517E+00
CY	-.13535E+01	0.	0.	-.46540E+00	-.66290E+00	-.22517E+00
CM	-.13488E+01	-.64251E+00	-.45133E+00	0.	0.	-.25092E+00
CLN	.13488E+01	0.	0.	.45133E+00	.64251E+00	.25092E+00
CLL	.46320E+13	.57374E+00	.41884E+00	-.41884E+00	.57374E+00	.13507E+13

## FOLLOWING ARE IN WIND-AXIS SYSTEM

CL	.18477E+01	.45808E+00	.32145E+00	.32145E+00	.45808E+00	.30849E+00
CY-IND	.62261E+12	.46877E+00	.32909E+00	-.32909E+00	-.46877E+00	.63505E+12
CDI	.02193E+00	.10066E+00	.71199E-01	.71199E-01	.10066E+00	.78207E-01
CDI/CL+2	.12095E+00					
CM-IND	-.19070E+01	-.45432E+00	-.31914E+00	-.31914E+00	-.45432E+00	-.36852E+00
CLN-IND	-.56577E+12	-.29950E+00	-.41222E+00	.41222E+00	.29950E+00	-.56844E+12

NOTE: L.E. OF LEAD PANEL IN FIRST CHORD-ISE HO- IS SUPERSONIC

SPARWISE DISTRIBUTIONS

I	Y/(B/2)	C* $\alpha$ /C/(2* $\alpha$ )	CT* $\alpha$ /C/(2* $\alpha$ )	CY1* $\alpha$ /C/(2* $\alpha$ )	CY2* $\alpha$ /C/(2* $\alpha$ )	CS* $\alpha$ /C/(2* $\alpha$ )	CSINT	YBAR	GAMNET(I)	GAMMA,LF/VINF	XLE
1	.65426	.20280	0.00000	0.00000	.00352	0.00000	0.00000	0.00000	.94959	0.00000	.13334
2	.85415	.18342	0.00000	0.00000	.00194	0.00000	0.00000	0.00000	.09066	0.00000	.40340
3	1.05402	.16892	0.00000	0.00000	.00223	0.00000	0.00000	0.00000	.06743	0.00000	.67342
4	1.25385	.14501	0.00000	0.00000	.00198	0.00000	0.00000	0.00000	.11185	0.00000	.94341
5	1.45367	.10335	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.19506	0.00000	1.21335
6	1.55556	0.00000							.48420		

SHMFY = 0.  
 SHMFV = 0.  
 SHMFY2 = .72775E-07  
 SHMFV2 = .27974E-01

STOP EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(Q* $\alpha$ *TIPCHORD)	GAMMA,SE /VINF	YBAR	XSE
1	1	.33333	.00340	.00040	3.64000	1.35100
2	2	.66667	.03845	.00742	3.64000	2.10067
3	3	1.00000	.04624	.01563	3.64000	2.85033

\*\*\*\*T.F. FIN VORTEX INFO\*\*\*\*

IVRT GAMMA/VINF Y.C.G.

1 .94911 3.15420

Figure 10.- Continued.

----- LEFT TIP-----

# SPACIAL DISTRIBUTIONS

I	Y/(R/2)	CN+C/(2*H)	CT+C/(2*H)	CY1+C/(2*H)	CYTOT+C/(2*H)	CS+C/(2*H)	CSTNT	VRAR	GAMNET(I)	GAMMA,IE/VINF	XLE
7	-.69426	.11396	0.00000	0.00000	-.00097	0.00000	0.00000	0.00000	.53369	0.00000	.13334
8	-.85415	.11759	0.00000	0.00000	.00142	0.00000	0.00000	0.00000	.01743	0.00000	.40340
9	-1.05402	.12647	0.00000	0.00000	-.00085	0.00000	0.00000	0.00000	.04116	0.00000	.67342
10	-1.25346	.12104	0.00000	0.00000	-.00310	0.00000	0.00000	0.00000	-.02535	0.00000	.94641
11	-1.45307	.08490	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.16916	0.00000	1.21335
12	-1.55556	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.39778	0.00000	

SUMFX = 0.  
 SUMFY1 = 0.  
 SUMFY2 = -.29015E+02  
 SUMFT2 = -.26735E+01

# SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SECTION FORCE PER UNIT LENGTH /(C+TIPCHORD)	GAMMA,SE /VINF	YHAR	XSE
1	1	.33333	-.00396	-.00070	-3.64000	1.35100
2	2	.66667	-.03961	-.00773	-3.64000	2.10067
3	3	1.00000	-.04062	-.01493	-3.64000	2.85033

\*\*\*\*T.E. FIN VERTX INFO\*\*\*\*

IVRT GAMMA/VINF Y,C,G.

2 .05844 -2.09644  
 3 -.49187 -3.46600

Figure 10.- Continued.

-----UPPER WING-----

# SPANWISE DISTRIBUTIONS

I	Z/(R/2)	CN*C/(2*B)	CT*C/(2*B)	CZ1*C/(2*B)	CZTOT*C/(2*B)	CS*C/(2*B)	CSIN	ZBAR	GAMNET(I)	GAMMA,LE/VINF	XLE
13	.65426	.11398	0.00000	0.00000	.00097	0.00000	0.00000	0.00000	-.53369	0.00000	.13334
14	.85415	.11769	0.00000	0.00000	-.00142	0.00000	0.00000	0.00000	-.01743	0.00000	.40340
15	1.05402	.12647	0.00000	0.00000	.00085	0.00000	0.00000	0.00000	-.04116	0.00000	.67342
16	1.25386	.12104	0.00000	0.00000	.00310	0.00000	0.00000	0.00000	.02535	0.00000	.94341
17	1.45367	.08490	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.16916	0.00000	1.21335
18	1.55556	0.00000							.39778		

SUMFX = 0.  
 SUMFZ1 = 0.  
 SUMFZ2 = .29015E-02  
 SUMFT2 = .26735E-01

# SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(Q*TIPCHORD)	GAMMA,SE /VINF	ZBAR	XSE
1	4	.33333	.00396	.00070	3.64000	1.35100
2	5	.66667	.03961	.00773	3.64000	2.10067
3	6	1.00000	.04062	.01493	3.64000	2.85033

\*\*\*\*T.F. FIN VORTEX INFO\*\*\*\*

IVRT GAMMA/VINF Z,C,G.

4 -.05844 2.09688  
 5 .59187 3.46609

## SPANWISE DISTRIBUTIONS

I	Z/(R/2)	CN*C/(2*H)	CT*C/(2*H)	CZ1*C/(2*H)	CZTOT*C/(2*H)	CS*C/(2*H)	CSINT	ZBAR	GAMNET(I)	GAMMA,LE/VINF	XLE
10	-.65426	.20280	0.00000	0.00000	-.00352	0.00000	0.00000	0.00000	-.94959	0.00000	.13334
20	-.85415	.18342	0.00000	-0.00000	-.00108	0.00000	0.00000	0.00000	-.09046	0.00000	.40340
21	-1.05402	.16892	0.00000	0.00000	-.00223	0.00000	0.00000	0.00000	-.06783	0.00000	.67342
22	-1.25388	.14501	0.00000	0.00000	-.00198	0.00000	0.00000	0.00000	-.11185	0.00000	.94341
23	-1.45367	.10335	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.19506	0.00000	1.21335
24	-1.55556	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.48420		

SUMFX = 0.  
 SUMFZ1 = 0.  
 SUMFZ2 = -.72775E-02  
 SUMFZ3 = -.27974E-01

## SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE Z(TIPCHORD)	SUCTION FORCE PER UNIT LENGTH Z(C*TIPCHORD)	GAMMA,SF /VINF	ZBAR	XSE
1	7	.35333	-.00340	-.00040	-5.64000	1.35100
2	8	.60067	-.03845	-.00742	-3.64000	2.10067
3	9	1.00000	-.04624	-.01543	-3.64000	2.45033

\*\*\*\*\*E. FIN VORTEX THEO\*\*\*\*\*

TVRT GAMMA/VINF Z.C.G.

4 -.94911 -3.15024

\*\*\*\*\*  
AFT OF LEADING EDGE OF FIN RIVETINGS

PRESSURE COEFFICIENTS AT PRINTS ON BODY MERIDIANS

J	THETA, DEG.	XB	YH	ZH	UTOT	VTOT	WTOT	CP, LIN.	CP, BERN.	DR/DX	P/PINF, BERN.	P/PINF, LIN.
BODY RING# 1												
1	11,25000	20,94000	1,25052	.24874	.10899	.12438	.10735	-.21798	-.20414	0,00000	.58702	.55903
2	33,75000	20,94000	1,06014	.70836	.02510	-.05031	.20926	-.05019	-.17282	0,00000	.65039	.69846
3	56,25000	20,94000	.70836	1,06014	-.03280	-.16979	.05031	.06568	-.04375	0,00000	.91148	1,13287
4	78,75000	20,94000	.24874	1,25052	-.06909	-.03950	-.14496	.13818	.15867	0,00000	1,32099	1,27954
5	101,25000	20,94000	-.24874	1,25052	.05658	.29243	-.17075	-.11515	-.06355	0,00000	.87145	.77109
6	123,75000	20,94000	-.70836	1,06014	.00457	.26577	-.10263	-.01273	.03526	0,00000	1,07133	.97424
7	146,25000	20,94000	-1,06014	.70836	.00637	.10263	.03526	.01273	.03526	0,00000	1,07133	.97424
8	168,75000	20,94000	-1,25052	.24874	.05658	.17075	-.29243	-.11515	-.06355	0,00000	.87145	.77109
9	191,25000	20,94000	-1,25052	-.24874	-.06909	.14496	.03950	.13818	.15867	0,00000	1,32099	1,27954
10	213,75000	20,94000	-1,06014	-.70836	-.03280	-.16979	.05031	.06568	-.04375	0,00000	.91148	1,13287
11	236,25000	20,94000	-.70836	-1,06014	.02510	.20926	.08031	-.05019	-.17282	0,00000	.65039	.69846
12	258,75000	20,94000	-.24874	-1,25052	.10899	.10735	-.12438	-.21798	-.20414	0,00000	.58702	.55903
13	281,25000	20,94000	.24874	-1,25052	-.10899	.13923	-.21068	.24096	.31248	0,00000	1,63216	1,48746
14	303,75000	20,94000	.70836	-1,06014	-.04817	.15212	-.20247	.09635	.16708	0,00000	1,33800	1,19491
15	326,25000	20,94000	1,06014	-.70836	-.04817	.20247	-.15212	.09635	.16708	0,00000	1,33800	1,19491
16	348,75000	20,94000	1,25052	-.24874	-.12048	.21068	-.03923	.24096	.31248	0,00000	1,63216	1,48746
BODY RING# 2												
1	11,25000	22,14000	1,25052	.24874	.10843	.12970	.08047	-.21286	-.18996	0,00000	.61571	.56939
2	33,75000	22,14000	1,06014	.70836	.03484	-.02592	.12779	-.06968	-.12572	0,00000	.74567	.85903
3	56,25000	22,14000	.70836	1,06014	-.00816	-.04119	-.00899	.09632	.06189	0,00000	1,12521	1,19486
4	78,75000	22,14000	.24874	1,25052	-.09199	-.01047	.15087	.18399	.22506	0,00000	1,45530	1,37220
5	101,25000	22,14000	-.24874	1,25052	.08900	.30800	-.16680	-.17800	-.12513	0,00000	.74687	.63991
6	123,75000	22,14000	-.70836	1,06014	.06068	.27827	-.09511	-.12136	-.07382	0,00000	.85066	.75409
7	146,25000	22,14000	-1,06014	.70836	.06068	.09511	-.27827	-.12136	-.07382	0,00000	.85066	.75409
8	168,75000	22,14000	-1,25052	.24874	.08900	.16680	-.30800	-.17800	-.12513	0,00000	.74687	.63991
9	191,25000	22,14000	-1,25052	-.24874	-.09199	.15087	.01047	.18399	.22506	0,00000	1,45530	1,37220
10	213,75000	22,14000	-1,06014	-.70836	-.08900	.08900	.08119	.09632	.06189	0,00000	1,12521	1,19486
11	236,25000	22,14000	-.70836	-1,06014	.03484	-.12779	.02592	-.06968	-.12572	0,00000	.74567	.85903
12	258,75000	22,14000	-.24874	-1,25052	.10843	-.08047	-.12970	-.21286	-.18996	0,00000	.61571	.56939
13	281,25000	22,14000	.24874	-1,25052	-.13102	.02976	-.21254	.26204	.33398	0,00000	1,67583	1,53010
14	303,75000	22,14000	.70836	-1,06014	-.16212	.15054	-.20351	.32425	.44280	0,00000	1,89578	1,65595
15	326,25000	22,14000	1,06014	-.70836	-.16212	.20351	-.15054	.32425	.44280	0,00000	1,89578	1,65595
16	348,75000	22,14000	1,25052	-.24874	-.13102	.21254	-.02976	.26204	.33398	0,00000	1,67583	1,53010
BODY RING# 3												
1	11,25000	23,34000	1,25052	.24874	.09347	.14430	.00695	-.18695	-.14480	0,00000	.70707	.62180
2	33,75000	23,34000	1,06014	.70836	.01523	-.01571	.06542	-.03046	-.04966	0,00000	.89954	.93838
3	56,25000	23,34000	.70836	1,06014	-.01296	-.06034	-.02592	.00788	.00788	0,00000	1,01593	1,05244
4	78,75000	23,34000	.24874	1,25052	.00349	-.05293	-.14251	-.00778	.00004	0,00000	1,00090	.98426

Figure 10.- Continued.



5	101,25000	23,34000	-.24874	1,25052	.14834	.34241	-.15880	-.29676	-.22665	0,00000	.54148	.39966
6	123,75000	23,34000	-.70836	1,06014	.13228	.26647	-.10396	-.26457	-.19226	0,00000	.61106	.46478
7	146,25000	23,34000	-1,06014	.70836	.13228	.10396	-.26647	-.26457	-.19226	0,00000	.61106	.46478
8	168,75000	23,34000	-1,25052	.24874	.14834	.15880	-.34241	-.27676	-.22665	0,00000	.54148	.39966
9	191,25000	23,34000	-1,25052	-.24874	.00340	.14251	.05293	-.00778	.00000	0,00000	1,00000	.98426
10	213,75000	23,34000	-1,06014	-.70836	-.01296	.02303	.06034	.02592	.00788	0,00000	1,01593	1,05244
11	236,25000	23,34000	-.70836	-1,06014	.01523	-.06542	-.01571	-.03046	-.04966	0,00000	.60954	.93838
12	258,75000	23,34000	-.24874	-1,25052	.09347	-.00695	-.14430	-.18695	-.14440	0,00000	.70717	.62180
13	281,25000	23,34000	.24874	-1,25052	-.11401	-.04527	-.22745	.22802	.25389	0,00000	1,51362	1,46128
14	303,75000	23,34000	.70836	-1,06014	-.16774	.12646	-.21958	.33549	.45252	0,00000	1,91545	1,67870
15	326,25000	23,34000	1,06014	-.70836	-.16774	.21958	-.12646	.33549	.45252	0,00000	1,91545	1,67870
16	348,75000	23,34000	1,25052	-.24874	-.11401	.22745	.04527	.22802	.25389	0,00000	1,51362	1,46128

Figure 10.- Concluded.

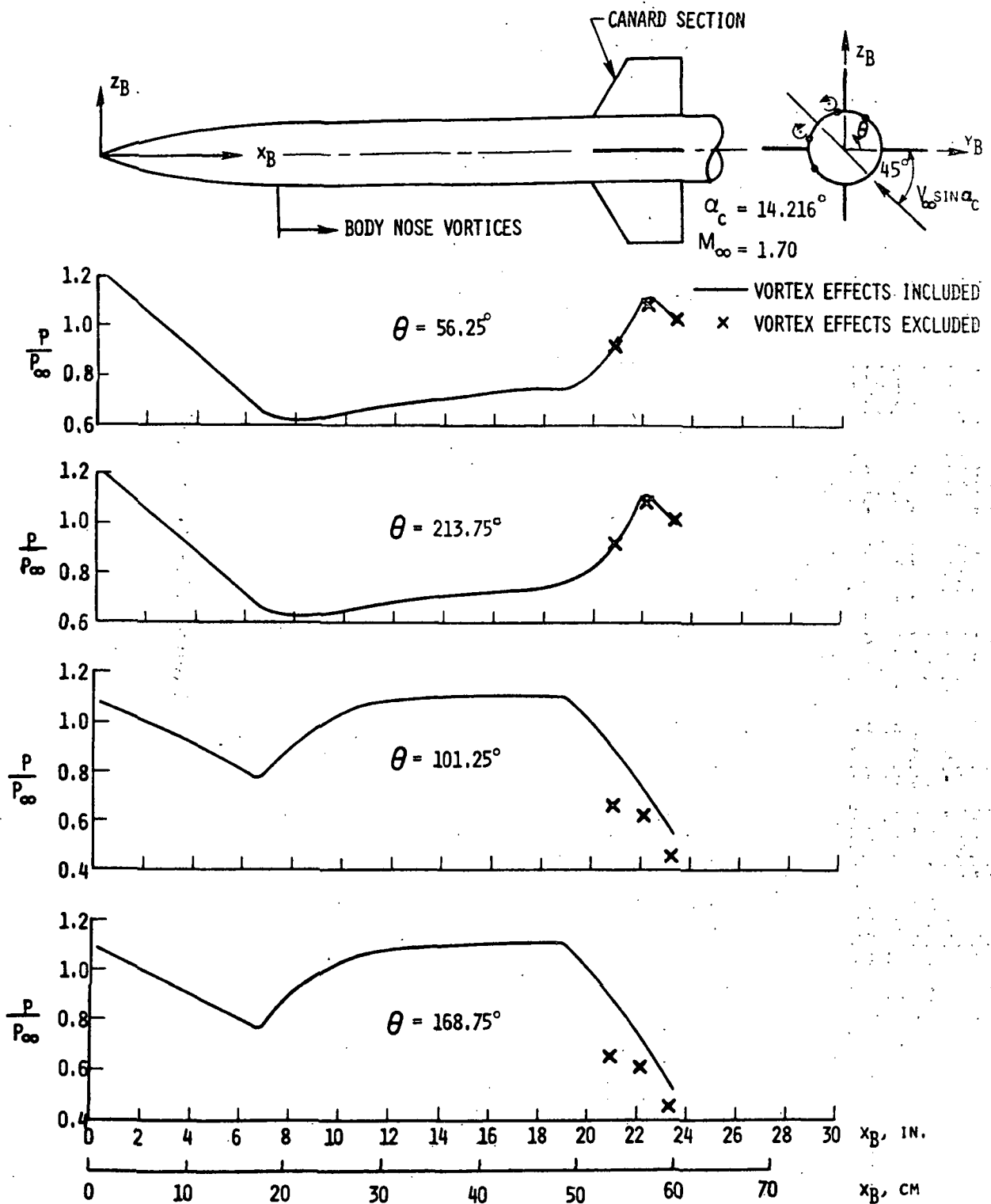


Figure 11(a).— Calculated pressure distributions along body meridians through canard section; first sample case.

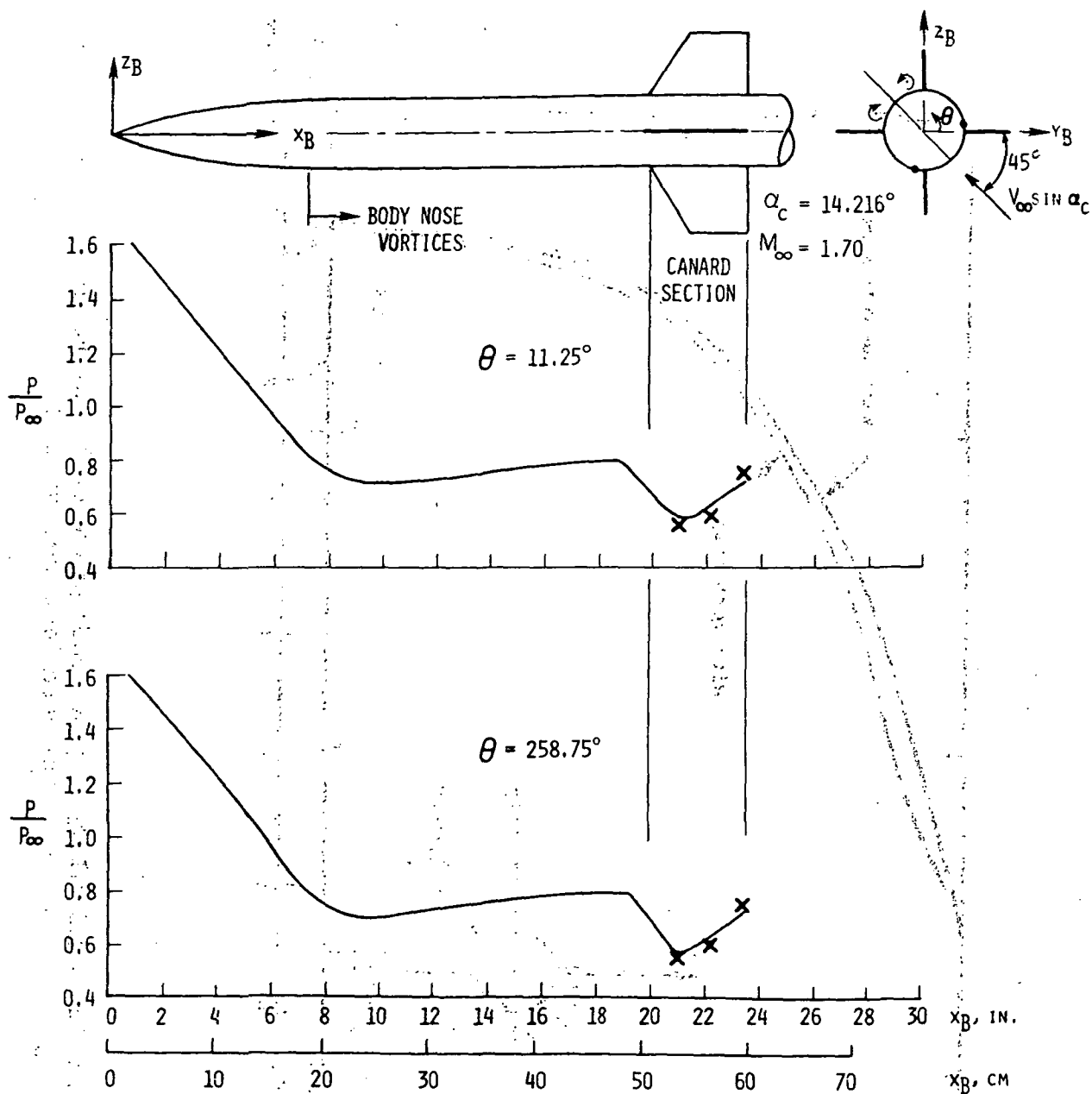


Figure 11(b).- Concluded.

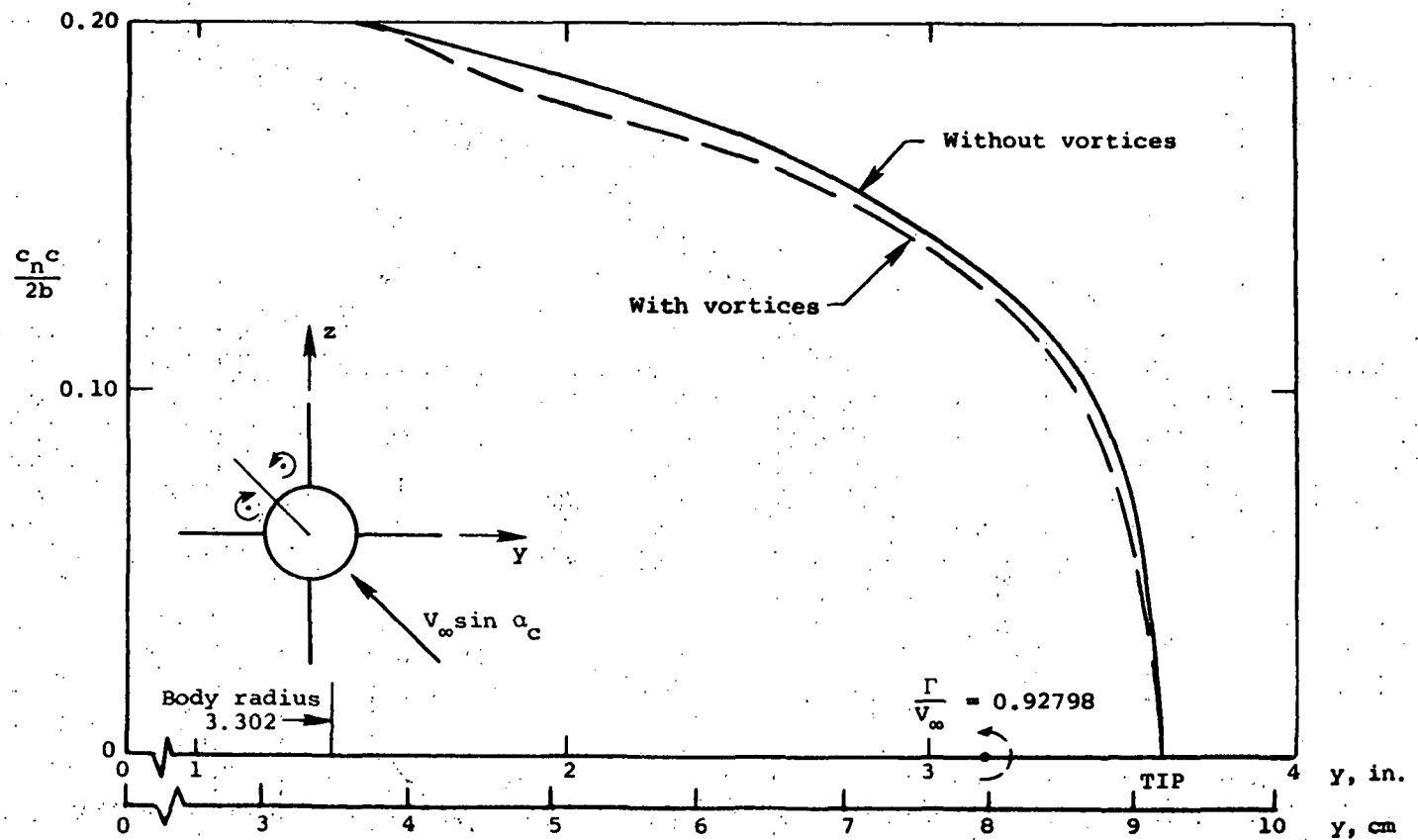


Figure 12.- Calculated span loading on right horizontal canard fin, first sample case, step 3.

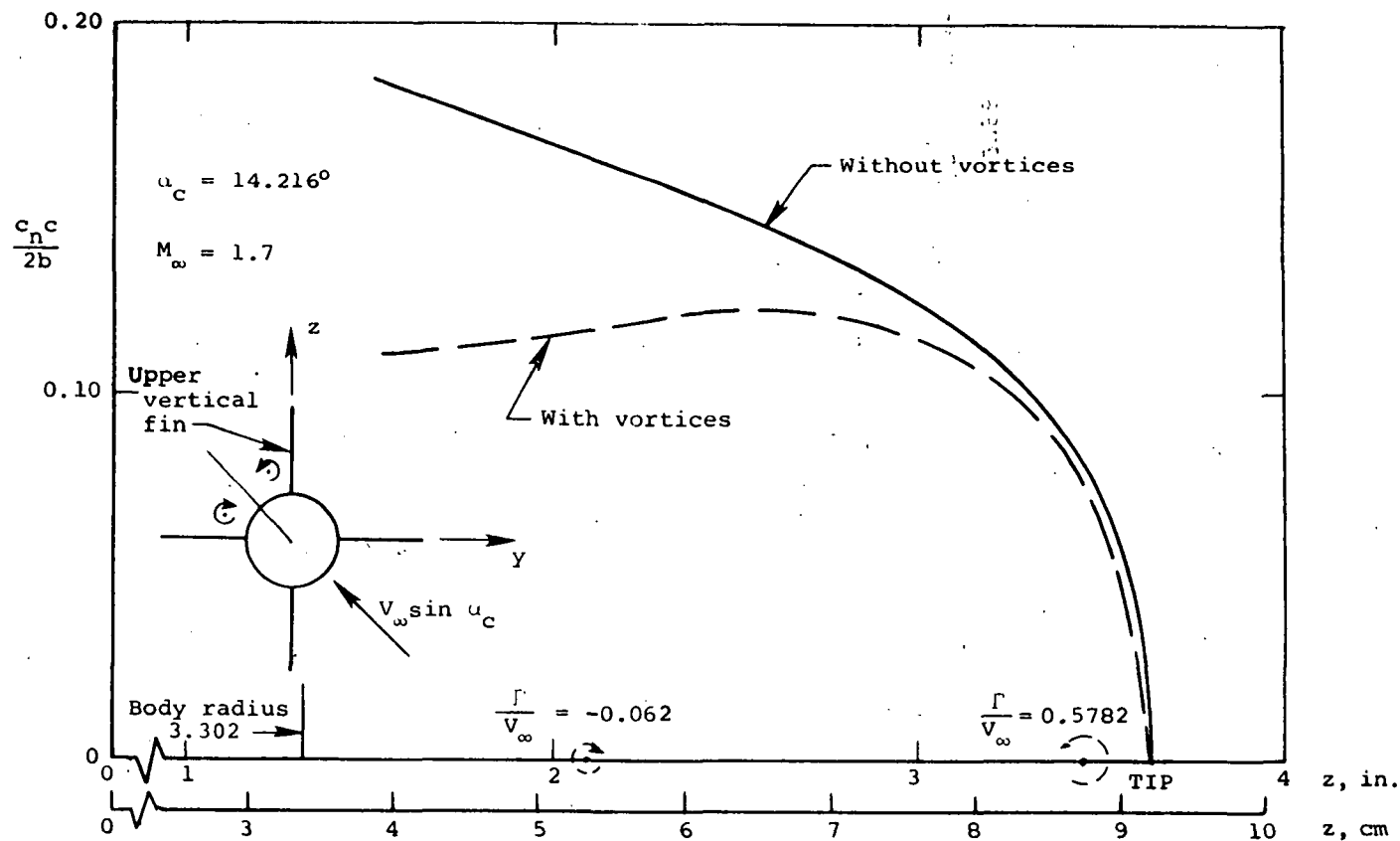
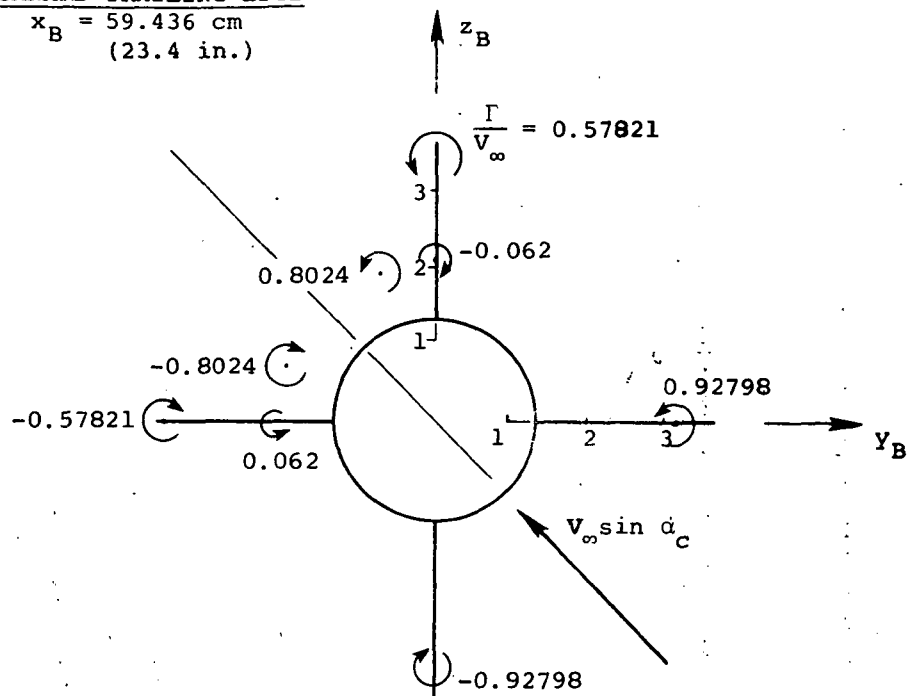


Figure 13.- Calculated span loading on the upper vertical fin, first sample case, step 3.

CANARD TRAILING EDGE

$x_B = 59.436 \text{ cm}$   
(23.4 in.)



BODY BASE

$x_B = 99.060 \text{ cm}$   
(39.0 in.)

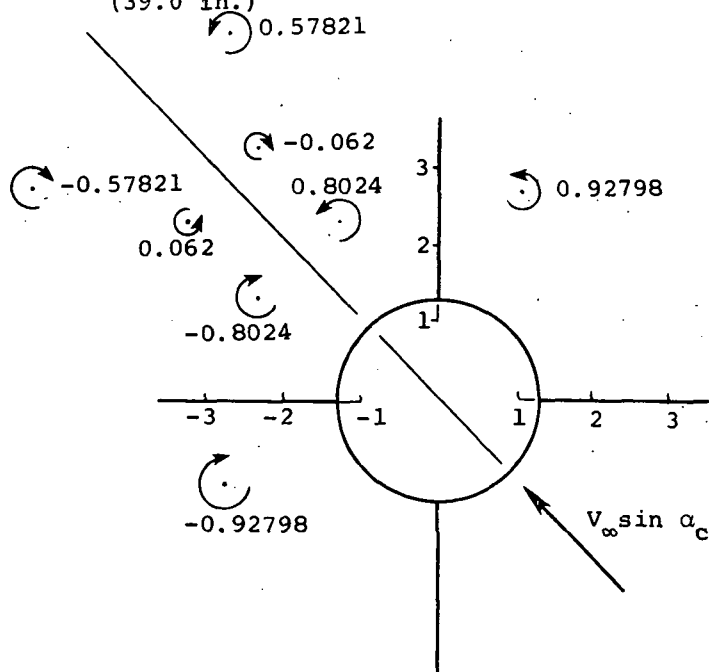


Figure 14.- Calculated vortex positions,  
first sample case, step 5.

1	4	26	1	1	0
39.0					
1.3					
35.4	1.3	36.751	3.64	39.0	3.64
14.216	45.0	0.0	0.0	0.0	39.00001
8	8	8	8	8	0.00001
8	8	8	8	8	0.35
-0.68451	1.9192	0.8024	-1.9192	0.68451	-0.8024
3.15424	0.0	0.94911	-2.09688	0.0	0.05844
-3.46609	0.0	-0.59187	0.0	2.09688	-0.05844
0.0	3.46609	0.59187	0.0	-3.15424	-0.94911
23.4	24.024	24.648	25.272	25.896	26.52
28.392	29.016	29.64	30.264	30.888	31.512
33.384	34.008	34.632	35.256	35.88	36.504
38.376	39.0				
0	0	0	0		
0					

Figure 15.- Input for program VPATH2, first sample case, step 5.

FIN GEOMETRY  
 FIN SEMISPAN = 3.64000  
 FIN ROOTCHORD = 3.60001  
 FIN ROOT L.E. X-STATION= 35.40000  
 L.E. Y-STATION= 1.30000  
 FIN TIP L.E. X-STATION = 36.75100  
 L.E. Y-STATION = 3.64000  
 FIN TIP T.E. X-STATION = 39.00000  
 T.E. Y-STATION = 3.64000  
 FIN ROOT T.E. X-STATION= 39.00001  
 T.E. Y-STATION= 1.30000

INCLUDED ANGLE OF ATTACK(DEG) = 14.21600 ROLL ANGLE(DEG) = 45.00000

PANEL DEFL.(DEG) :

DELTA1= 0.000 DELTA2= 0.000 DELTA3= 0.000 DELTA4= 0.000

\*\*\*PERMISSIBLE RELATIVE ERROR, AS USED IN INTEGRATION SCHEME = .10000E+04

VORTEX COORDINATES IN CROSS-FLow PLANE  
 INITIAL VORTEX POSITIONS AT X= 23.400

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI-SPAN S = 1.50000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.64451E+00	.19192E+01	.80240E+00
2	-.19192E+01	.68451E+00	-.80240E+00
3	.31542E+01	0.	.94911E+00
4	-.20969E+01	0.	.58440E+01
5	-.34661E+01	0.	-.54187E+00
6	0.	.20969E+01	-.58440E+01
7	0.	.34661E+01	.54187E+00
8	0.	.31542E+01	.94911E+00

X-STATION NO. 2 X=24.024 INTEGRATION STEP SIZE = .09984

Figure 16.- Output of program VPATH2, first sample case, step 5.



LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VRTX	V,VRTX	Z,VRTX	GAMMA/VINF
1	-.70738E+00	.19461E+01	.80240E+00
2	-.19461E+01	.70727E+00	-.80240E+00
3	.30865E+01	.10549E+00	.94911E+00
4	-.22397E+01	.50295E+00	.58440E+01
5	-.35540E+01	.12835E+00	-.59187E+00
6	-.80872E+01	.22397E+01	-.58440E+01
7	-.12871E+00	.35539E+01	.59187E+00
8	-.10505E+00	.30865E+01	.94911E+00

X-STATION NO. 3 X=24.046 INTEGRATION STEP SIZE = .19966

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VRTX	V,VRTX	Z,VRTX	GAMMA/VINF
1	-.73263E+00	.19738E+01	.80240E+00
2	-.19738E+01	.73252E+00	-.80240E+00
3	.30063E+01	.21217E+00	.94911E+00
4	-.23810E+01	.17808E+00	.58440E+01
5	-.35394E+01	.25624E+00	-.59187E+00
6	-.17871E+00	.23810E+01	-.58440E+01
7	-.25660E+00	.35394E+01	.59187E+00
8	-.21172E+00	.30063E+01	.94911E+00

X-STATION NO. 4 X=25.272 INTEGRATION STEP SIZE = .19966

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VRTX	V,VRTX	Z,VRTX	GAMMA/VINF
1	-.74032E+00	.20019E+01	.80240E+00
2	-.20019E+01	.74021E+00	-.80240E+00
3	.27315E+01	.32003E+00	.94911E+00
4	-.25136E+01	.29043E+00	.58440E+01
5	-.37227E+01	.38294E+00	-.59187E+00
6	-.29112E+00	.25136E+01	-.58440E+01
7	-.38338E+00	.37226E+01	.59187E+00
8	-.31457E+00	.29315E+01	.94911E+00

X-STATION NO. 5 X=25.496 INTEGRATION STEP SIZE = .39936

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VRTX	V,VRTX	Z,VRTX	GAMMA/VINF
1	-.77013E+00	.20298E+01	.80240E+00
2	-.20298E+01	.79003E+00	-.80240E+00
3	.24500E+01	.42908E+00	.94911E+00
4	-.26324E+01	.41257E+00	.58440E+01
5	-.38038E+01	.50814E+00	-.59187E+00
6	-.41532E+00	.26324E+01	-.58440E+01
7	-.50452E+00	.38037E+01	.59187E+00
8	-.42801E+00	.28560E+01	.94911E+00

X-STATION NO. 6 X=26.520 INTEGRATION STEP SIZE = .39936

Figure 16.- Continued.

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.82183E+00	.20574E+01	.80240E+00
2	-.20574E+01	.82154E+00	-.80240E+00
3	.27796E+01	.53929E+00	.94911E+00
4	-.27354E+01	.53923E+00	.58440E+01
5	-.34624E+01	.65174E+00	-.59187E+00
6	-.54005E+00	.27353E+01	-.58440E+01
7	-.63209E+00	.34828E+01	.59187E+00
8	-.53882E+00	-.27797E+01	-.94911E+00

X-STATION NO. 7 X=27.144 INTEGRATION STEP SIZE = .39936

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.85443E+00	.20845E+01	.80240E+00
2	-.20845E+01	.85435E+00	-.80240E+00
3	.27022E+01	.65964E+00	.94911E+00
4	-.28250E+01	.66517E+00	.58440E+01
5	-.39704E+01	.75356E+00	-.59187E+00
6	-.66704E+00	.28228E+01	-.58440E+01
7	-.75391E+00	.39603E+01	.59187E+00
8	-.65017E+00	-.27023E+01	-.94911E+00

X-STATION NO. 8 X=27.768 INTEGRATION STEP SIZE = .39936

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.88821E+00	.21111E+01	.80240E+00
2	-.21111E+01	.88813E+00	-.80240E+00
3	.26237E+01	.76107E+00	.94911E+00
4	-.28949E+01	.79060E+00	.58440E+01
5	-.40363E+01	.87357E+00	-.59187E+00
6	-.79151E+00	.28966E+01	-.58440E+01
7	-.87392E+00	.40362E+01	.59187E+00
8	-.76258E+00	-.26237E+01	-.94911E+00

X-STATION NO. 9 X=28.392 INTEGRATION STEP SIZE = .39936

Figure 16.- Continued.

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.92271E+00	.21372E+01	.80240E+00
2	-.21372E+01	.92263E+00	-.80240E+00
3	-.25437E+01	.87647E+00	.94911E+00
4	-.29594E+01	.91105E+00	.58440E+01
5	-.41110E+01	.99178E+00	-.59187E+00
6	-.91200E+00	.29589E+01	-.58440E+01
7	-.99212E+00	.41109E+01	.59187E+00
8	-.87598E+00	-.25438E+01	-.94911E+00

X-STATION NO. 10 X=29.016 INTEGRATION STEP SIZE = .39936

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.95776E+00	.21628E+01	.80240E+00
2	-.21628E+01	.95769E+00	-.80240E+00
3	-.24623E+01	.99073E+00	.94911E+00
4	-.30124E+01	.10269E+01	.58440E+01
5	-.41847E+01	.11082E+01	-.59187E+00
6	-.10279E+01	.30118E+01	-.58440E+01
7	-.11085E+01	.41846E+01	.59187E+00
8	-.90024E+00	-.24624E+01	-.94911E+00

X-STATION NO. 11 X=29.640 INTEGRATION STEP SIZE = .39936

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.99319E+00	.21879E+01	.80240E+00
2	-.21879E+01	.99312E+00	-.80240E+00
3	-.23791E+01	.11057E+01	.94911E+00
4	-.30579E+01	.11379E+01	.58440E+01
5	-.42575E+01	.12229E+01	-.59187E+00
6	-.11389E+01	.30572E+01	-.58440E+01
7	-.12232E+01	.42574E+01	.59187E+00
8	-.11052E+01	-.23792E+01	-.94911E+00

X-STATION NO. 12 X=30.264 INTEGRATION STEP SIZE = .79872

Figure 16.- Continued.

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.10289E+01	.22125E+01	.80240E+00
2	-.22125E+01	.10288E+01	-.80240E+00
3	.22942E+01	.12211E+01	.94911E+00
4	-.30974E+01	.12443E+01	.58440E+01
5	-.43297E+01	.13359E+01	-.59187E+00
6	-.12454E+01	.30965E+01	-.58440E+01
7	-.13363E+01	.43295E+01	.59187E+00
8	-.12206E+01	-.22943E+01	-.94911E+00

X=STATION NO. 13 X=30.885 INTEGRATION STEP SIZE = .79872

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.10546E+01	.22363E+01	.80240E+00
2	-.22363E+01	.10646E+01	-.80240E+00
3	.22073E+01	.13368E+01	.94911E+00
4	-.31320E+01	.13463E+01	.58440E+01
5	-.44013E+01	.14474E+01	-.59187E+00
6	-.13473E+01	.31309E+01	-.58440E+01
7	-.14477E+01	.44012E+01	.59187E+00
8	-.13363E+01	-.22074E+01	-.94911E+00

X=STATION NO. 14 X=31.512 INTEGRATION STEP SIZE = .79872

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.11024E+01	.22595E+01	.80240E+00
2	-.22595E+01	.11003E+01	-.80240E+00
3	.21165E+01	.14526E+01	.94911E+00
4	-.31627E+01	.14440E+01	.58440E+01
5	-.44726E+01	.15573E+01	-.59187E+00
6	-.14451E+01	.31615E+01	-.58440E+01
7	-.15576E+01	.44724E+01	.59187E+00
8	-.14521E+01	-.21186E+01	-.94911E+00

X=STATION NO. 15 X=32.136 INTEGRATION STEP SIZE = .79872

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
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Figure 16.- Continued.

1	-.11559E+01	.22817E+01	.80240E+00
2	-.22817E+01	.11559E+01	-.80240E+00
3	.20278E+01	.15681E+01	.94911E+00
4	-.31905E+01	.15379E+01	.58440E+01
5	-.44435E+01	.16657E+01	-.59187E+00
6	-.15389E+01	.31891E+01	-.58440E+01
7	-.16651E+01	.45434E+01	.59187E+00
8	-.15676E+01	-.20279E+01	-.94911E+00

X-STATION NO. 16      X=32.760      INTEGRATION STEP SIZE = .79872

LOCAL BODY RADIUS = 1.30000      LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.11712E+01	.23029E+01	.80240E+00
2	-.23029E+01	.11712E+01	-.80240E+00
3	.19352E+01	.16831E+01	.94911E+00
4	-.32158E+01	.16280E+01	.58440E+01
5	-.46143E+01	.17728E+01	-.59187E+00
6	-.16290E+01	.32142E+01	-.58440E+01
7	-.17732E+01	.46142E+01	.59187E+00
8	-.16820E+01	-.19353E+01	-.94911E+00

X-STATION NO. 17      X=33.384      INTEGRATION STEP SIZE = .79872

LOCAL BODY RADIUS = 1.30000      LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.12060E+01	.23229E+01	.80240E+00
2	-.23229E+01	.12060E+01	-.80240E+00
3	.18409E+01	.17975E+01	.94911E+00
4	-.32392E+01	.17147E+01	.58440E+01
5	-.46450E+01	.18787E+01	-.59187E+00
6	-.17157E+01	.32374E+01	-.58440E+01
7	-.14740E+01	.46448E+01	.59187E+00
8	-.17970E+01	-.18410E+01	-.94911E+00

X-STATION NO. 18      X=34.008      INTEGRATION STEP SIZE = .79872

LOCAL BODY RADIUS = 1.30000      LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.12401E+01	.23415E+01	.80240E+00
2	-.23415E+01	.12401E+01	-.80240E+00
3	.17450E+01	.19111E+01	.94911E+00
4	-.32613E+01	.17982E+01	.58440E+01
5	-.47555E+01	.19433E+01	-.59187E+00
6	-.17992E+01	.32593E+01	-.58440E+01
7	-.19430E+01	.47554E+01	.59187E+00
8	-.19106E+01	-.17452E+01	-.94911E+00

X-STATION NO. 19      X=34.632      INTEGRATION STEP SIZE = .79872

Figure 16.- Continued.

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.12735E+01	.23586E+01	.80240E+00
2	-.23587E+01	.12735E+01	-.80240E+00
3	.16478E+01	.20237E+01	.94911E+00
4	-.32823E+01	.18786E+01	.58440E-01
5	-.48261E+01	.20866E+01	-.59187E+00
6	-.18796E+01	.32802E+01	-.58440E-01
7	-.20871E+01	.48259E+01	.59187E+00
8	-.20232E+01	-.16480E+01	-.94911E+00

X-STATION NO. 20 X=35.256 INTEGRATION STEP SIZE = .79872

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 1.30000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.13058E+01	.23739E+01	.80240E+00
2	-.23740E+01	.13058E+01	-.80240E+00
3	.15495E+01	.21354E+01	.94911E+00
4	-.33028E+01	.19563E+01	.58440E-01
5	-.48966E+01	.21892E+01	-.59187E+00
6	-.19572E+01	.33004E+01	-.58440E-01
7	-.21895E+01	.48964E+01	.59187E+00
8	-.21349E+01	-.15497E+01	-.94911E+00

X-STATION NO. 21 X=35.880 INTEGRATION STEP SIZE = .15600

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 2.13138

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.13363E+01	.23855E+01	.80240E+00
2	-.23856E+01	.13363E+01	-.80240E+00
3	.14500E+01	.22455E+01	.94911E+00
4	-.33221E+01	.20309E+01	.58440E-01
5	-.49667E+01	.22905E+01	-.59187E+00
6	-.20318E+01	.33195E+01	-.58440E-01
7	-.22908E+01	.49665E+01	.59187E+00
8	-.22450E+01	-.14501E+01	-.94911E+00

X-STATION NO. 22 X=36.504 INTEGRATION STEP SIZE = .15600

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 3.21218

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	-.13557E+01	.23814E+01	.80240E+00
2	-.23815E+01	.13558E+01	-.80240E+00
3	.13547E+01	.23508E+01	.94911E+00
4	-.33329E+01	.20992E+01	.58440E-01
5	-.50321E+01	.23904E+01	-.59187E+00
6	-.21000E+01	.33301E+01	-.58440E-01
7	-.23907E+01	.50319E+01	.59187E+00
8	-.23503E+01	-.13548E+01	-.94911E+00

Figure 16.- Continued.

X-STATION NO. 23 X=37.124 INTEGRATION STEP SIZE = .31200

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 3.64000

VORTEX	V,VRTX	Z,VRTX	GAMMA/VINF
1	-.13564E+01	.23648E+01	.80240E+00
2	-.23640E+01	.13564E+01	-.80240E+00
3	.12754E+01	.24445E+01	.94911E+00
4	-.33298E+01	.21551E+01	.58440E+01
5	-.50477E+01	.24440E+01	-.59187E+00
6	-.21554E+01	.33269E+01	-.58440E+01
7	-.24443E+01	.50875E+01	.59187E+00
8	-.24440E+01	-.12754E+01	-.94911E+00

X-STATION NO. 24 X=37.752 INTEGRATION STEP SIZE = .62400

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 3.64000

VORTEX	V,VRTX	Z,VRTX	GAMMA/VINF
1	-.13546E+01	.23648E+01	.80240E+00
2	-.23649E+01	.13546E+01	-.80240E+00
3	.11981E+01	.25470E+01	.94911E+00
4	-.33275E+01	.22076E+01	.58440E+01
5	-.51432E+01	.25441E+01	-.59187E+00
6	-.22082E+01	.33244E+01	-.58440E+01
7	-.25844E+01	.51430E+01	.59187E+00
8	-.25465E+01	-.11983E+01	-.94911E+00

X-STATION NO. 25 X=38.376 INTEGRATION STEP SIZE = .62400

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 3.64000

VORTEX	V,VRTX	Z,VRTX	GAMMA/VINF
1	-.13520E+01	.23281E+01	.80240E+00
2	-.23282E+01	.13520E+01	-.80240E+00
3	.11204E+01	.26476E+01	.94911E+00
4	-.33281E+01	.22545E+01	.58440E+01
5	-.51999E+01	.26790E+01	-.59187E+00
6	-.22500E+01	.33245E+01	-.58440E+01
7	-.26793E+01	.51997E+01	.59187E+00
8	-.26471E+01	-.11209E+01	-.94911E+00

X-STATION NO. 26 X=39.006 INTEGRATION STEP SIZE = .62400

LOCAL BODY RADIUS = 1.30000 LOCAL SEMI SPAN S = 3.64000

VORTEX	V,VRTX	Z,VRTX	GAMMA/VINF
1	-.13485E+01	.23086E+01	.80240E+00
2	-.23086E+01	.13486E+01	-.80240E+00
3	.10430E+01	.27506E+01	.94911E+00

Figure 16.- Continued.

4	-.33316E+01	.23082E+01	.58440E+01
5	-.52578E+01	.27729E+01	-.59187E+00
6	-.23086E+01	.33282E+01	-.58440E+01
7	-.27732E+01	.52578E+01	.59187E+00
8	-.27540E+01	-.10432E+01	-.94011E+00

# CROSSFLOW VELOCITIES AT CONTROL POINTS INDUCED BY VORTICES AND THEIR IMAGES

IC	X, BODY	Y, BODY	Z, BODY	V	W
1	.36631E+02	.15310E+01	0.	.22541E-01	-.74105E-01
2	.37787E+02	.15310E+01	0.	.19927E-01	-.67006E-01
3	.36942E+02	.15310E+01	0.	.17798E-01	-.61175E-01
4	.36816E+02	.19987E+01	0.	.41619E-01	-.45614E-01
5	.37481E+02	.19987E+01	0.	.37375E-01	-.42293E-01
6	.38947E+02	.19987E+01	0.	.33859E-01	-.39479E-01
7	.37000E+02	.24664E+01	0.	.44308E-01	-.26003E-01
8	.37976E+02	.24664E+01	0.	.40555E-01	-.25916E-01
9	.38951E+02	.24664E+01	0.	.37364E-01	-.24108E-01
10	.37185E+02	.29340E+01	0.	.40999E-01	-.13556E-01
11	.38070E+02	.29340E+01	0.	.38248E-01	-.13699E-01
12	.38956E+02	.29340E+01	0.	.35851E-01	-.13763E-01
13	.37369E+02	.34016E+01	0.	.36017E-01	-.60080E-02
14	.38165E+02	.34016E+01	0.	.34184E-01	-.65582E-02
15	.38960E+02	.34016E+01	0.	.32528E-01	-.70081E-02
16	.36631E+02	-.15310E+01	0.	.25922E-01	-.24335E+00
17	.37787E+02	-.15310E+01	0.	.24109E-01	-.25303E+00
18	.38942E+02	-.15310E+01	0.	.19507E-01	-.25801E+00
19	.36816E+02	-.19987E+01	0.	.51219E-01	-.17161E+00
20	.37481E+02	-.19987E+01	0.	.53408E-01	-.18544E+00
21	.38947E+02	-.19987E+01	0.	.48996E-01	-.19858E+00
22	.37000E+02	-.24664E+01	0.	.59843E-01	-.91572E-01
23	.37976E+02	-.24664E+01	0.	.70149E-01	-.10355E+00
24	.38951E+02	-.24664E+01	0.	.84330E-01	-.12168E+00
25	.37185E+02	-.29340E+01	0.	.56495E-01	-.21821E-01
26	.38070E+02	-.29340E+01	0.	.75910E-01	-.23056E-01
27	.36956E+02	-.29340E+01	0.	.98558E-01	-.29250E-01
28	.37369E+02	-.34016E+01	0.	.43993E-01	.14325E+01
29	.38165E+02	-.34016E+01	0.	.57886E-01	.19927E-01
30	.38960E+02	-.34016E+01	0.	.74961E-01	.25398E-01
31	.36631E+02	.73521E-13	.15310E+01	.24338E+00	-.25911E-01
32	.37787E+02	.73521E-13	.15310E+01	.25305E+00	-.24092E-01
33	.38942E+02	.73521E-13	.15310E+01	.25802E+00	-.19486E-01
34	.36816E+02	.95983E-13	.19987E+01	.17165E+00	-.51210E-01
35	.37481E+02	.95983E-13	.19987E+01	.18549E+00	-.53383E-01
36	.38947E+02	.95983E-13	.19987E+01	.19861E+00	-.48956E-01
37	.37000E+02	.11844E-12	.24664E+01	.91616E-01	-.59862E-01
38	.37976E+02	.11844E-12	.24664E+01	.10340E+00	-.74159E-01
39	.38951E+02	.11844E-12	.24664E+01	.12174E+00	-.84319E-01
40	.37185E+02	.14090E-12	.29340E+01	.21847E-01	-.56537E-01
41	.38070E+02	.14090E-12	.29340E+01	.23094E-01	-.75960E-01
42	.36956E+02	.14090E-12	.29340E+01	.29311E-01	-.98614E-01
43	.37369E+02	.16335E-12	.34016E+01	-.14321E-01	-.44031E-01
44	.38165E+02	.16335E-12	.34016E+01	-.19920E-01	-.57935E-01
45	.38960E+02	.16335E-12	.34016E+01	-.25385E-01	-.75025E-01
46	.36631E+02	-.73521E-13	-.15310E+01	.74107E-01	-.22546E-01
47	.37787E+02	-.73521E-13	-.15310E+01	.67006E-01	-.19931E-01
48	.38942E+02	-.73521E-13	-.15310E+01	.61173E-01	-.17801E-01
49	.36816E+02	-.95983E-13	-.19987E+01	.45611E-01	-.41628E-01
50	.37481E+02	-.95983E-13	-.19987E+01	.42284E-01	-.37381E-01
51	.38947E+02	-.95983E-13	-.19987E+01	.39475E-01	-.33864E-01
52	.37000E+02	-.11844E-12	-.24664E+01	.25997E-01	-.44314E-01
53	.37976E+02	-.11844E-12	-.24664E+01	.25009E-01	-.40561E-01
54	.38951E+02	-.11844E-12	-.24664E+01	.24101E-01	-.37368E-01
55	.37185E+02	-.14090E-12	-.29340E+01	.13548E-01	-.41002E-01

Figure 16.- Continued.



56	.38770E+02	-.14040E+12	-.29340E+01	.13092E-01	-.36261E-01
57	.38956E+02	-.14040E+12	-.29340E+01	.13750E-01	-.35954E-01
58	.37369E+02	-.14335E+12	-.34016E+01	.60006E-02	-.36018E-01
59	.38165E+02	-.16335E+12	-.34016E+01	.65510E-02	-.34145E-01
60	.38960E+02	-.16335E+12	-.40016E+01	.70012E-02	-.32529E-01
61	.36540E+02	.12505E+01	.24874E+00	.21274E-01	-.12973E+00
62	.36540E+02	.10601E+01	.70836E+00	.12747E+00	-.20246E+00
63	.36540E+02	.70836E+00	.10601E+01	.28773E+00	-.19570E+00
64	.36540E+02	.24874E+00	.12505E+01	.32366E+00	-.60836E-01
65	.36540E+02	-.24874E+00	.12505E+01	.24801E+00	.53505E-01
66	.36540E+02	-.70836E+00	.10601E+01	.91774E-01	.73741E-01
67	.36540E+02	-.10601E+01	.70836E+00	-.73710E-01	-.91728E-01
68	.36540E+02	-.12505E+01	.24874E+00	-.53496E-01	-.24796E+00
69	.36540E+02	-.12505E+01	-.24874E+00	.60631E-01	-.32364E+00
70	.36540E+02	-.10601E+01	-.70836E+00	.19573E+00	-.26788E+00
71	.36540E+02	-.70836E+00	-.10601E+01	.20250E+00	-.12770E+00
72	.36540E+02	-.24874E+00	-.12505E+01	.12675E+00	-.21275E-01
73	.36540E+02	.24874E+00	-.12505E+01	.61400E-01	.14660E-01
74	.36540E+02	.70836E+00	-.10601E+01	.14602E-01	.12662E-01
75	.36540E+02	.10601E+01	-.70836E+00	-.12066E-01	-.14607E-01
76	.36540E+02	.12505E+01	-.24874E+00	-.14860E-01	-.61401E-01
77	.37740E+02	.12505E+01	.24874E+00	.19040E-01	-.11463E+00
78	.37740E+02	.10601E+01	.70836E+00	.11255E+00	-.17859E+00
79	.37740E+02	.70836E+00	.10601E+01	.26421E+00	-.14124E+00
80	.37740E+02	.24874E+00	.12505E+01	.32649E+00	-.62557E-01
81	.37740E+02	-.24874E+00	.12505E+01	.25853E+00	.55706E-01
82	.37740E+02	-.70836E+00	.10601E+01	.95493E-01	.77032E-01
83	.37740E+02	-.10601E+01	.70836E+00	-.76997E-01	-.95841E-01
84	.37740E+02	-.12505E+01	.24874E+00	-.55699E-01	-.25849E+00
85	.37740E+02	-.12505E+01	-.24874E+00	-.62555E-01	-.32650E+00
86	.37740E+02	-.10601E+01	-.70836E+00	.18130E+00	-.26427E+00
87	.37740E+02	-.70836E+00	-.10601E+01	.17462E+00	-.11257E+00
88	.37740E+02	-.24874E+00	-.12505E+01	.11464E+00	-.19041E-01
89	.37740E+02	.24874E+00	-.12505E+01	.55514E-01	.13401E-01
90	.37740E+02	.70836E+00	-.10601E+01	.13307E-01	.10989E-01
91	.37740E+02	.10601E+01	-.70836E+00	-.10893E-01	-.13314E-01
92	.37740E+02	.12505E+01	-.24874E+00	-.13401E-01	-.55514E-01
93	.38940E+02	.12505E+01	.24874E+00	.17227E-01	-.10314E+00
94	.38940E+02	.10601E+01	.70836E+00	.99922E-01	-.15845E+00
95	.38940E+02	.70836E+00	.10601E+01	.23901E+00	-.16495E+00
96	.38940E+02	.24874E+00	.12505E+01	.31998E+00	-.62611E-01
97	.38940E+02	-.24874E+00	.12505E+01	.26666E+00	.57132E-01
98	.38940E+02	-.70836E+00	.10601E+01	.10028E+00	.80495E-01
99	.38940E+02	-.10601E+01	.70836E+00	-.80458E-01	-.10022E+00
100	.38940E+02	-.12505E+01	.24874E+00	-.57127E-01	-.26662E+00
101	.38940E+02	-.12505E+01	-.24874E+00	.62611E-01	-.32000E+00
102	.38940E+02	-.10601E+01	-.70836E+00	.14499E+00	-.23906E+00
103	.38940E+02	-.70836E+00	-.10601E+01	.15848E+00	-.49937E-01
104	.38940E+02	-.24874E+00	-.12505E+01	.16318E+00	-.17227E-01
105	.38940E+02	.24874E+00	-.12505E+01	.50709E-01	.12211E-01
106	.38940E+02	.70836E+00	-.10601E+01	.12245E-01	.10108E-01
107	.38940E+02	.10601E+01	-.70836E+00	-.10113E-01	-.12252E-01
108	.38940E+02	.12505E+01	-.24874E+00	-.12212E-01	-.50714E-01
109	.25145E+02	.12750E+01	.25342E+00	.51694E-01	-.26088E+00
110	.25145E+02	.12010E+01	.49749E+00	.48361E-01	-.23745E+00
111	.25145E+02	.17809E+01	.72224E+00	.13145E+00	-.19612E+00
112	.25145E+02	.91924E+00	.91924E+00	.15447E+00	-.15447E+00
113	.25145E+02	.72224E+00	.10449E+01	.17758E+00	-.11866E+00
114	.25145E+02	.49749E+00	.12010E+01	.20420E+00	-.46245E-01
115	.25145E+02	.25342E+00	.12750E+01	.25233E+00	-.50194E-01
116	.25145E+02	-.46245E-01	.13060E+01	.31195E+00	.11188E-09
117	.25145E+02	-.25342E+00	.12750E+01	.35000E+00	.72225E-01
118	.25145E+02	-.49749E+00	.12010E+01	.32579E+00	.13497E+00
119	.25145E+02	-.72224E+00	.10449E+01	.17191E+00	.11488E+00
120	.25145E+02	-.91924E+00	.91924E+00	.21260E+00	.19278E-04

Figure 16.- Continued.

121	.25145E+02	-.10809E+01	.72224E+00	-.11485E+00	-.17187E+00
122	.25145E+02	-.12010E+01	.49749E+00	-.13496E+00	-.32577E+00
123	.25145E+02	-.12750E+01	.25362E+00	-.72226E+01	-.35000E+00
124	.25145E+02	-.13000E+01	-.93250E-09	.22377E-09	-.31196E+00
125	.25145E+02	-.12750E+01	-.25362E+00	.50195E+01	-.25232E+00
126	.25145E+02	-.12010E+01	-.49749E+00	.86201E+01	-.20819E+00
127	.25145E+02	-.10809E+01	-.72224E+00	.11665E+00	-.17757E+00
128	.25145E+02	-.91924E+00	-.91924E+00	.15445E+00	-.15445E+00
129	.25145E+02	-.72224E+00	-.10809E+01	.19610E+00	-.13103E+00
130	.25145E+02	-.49749E+00	-.12010E+01	.23743E+00	-.98352E-01
131	.25145E+02	-.25362E+00	-.12750E+01	.26098E+00	-.51893E-01
132	.25145E+02	.13968E-08	-.13000E+01	.24729E+00	.26608E-09
133	.25145E+02	.25362E+00	-.12750E+01	.19580E+00	.38953E-01
134	.25145E+02	.49749E+00	-.12010E+01	.12534E+00	.51432E-01
135	.25145E+02	.72224E+00	-.10809E+01	.56213E-01	.37546E-01
136	.25145E+02	.91924E+00	-.91924E+00	.18354E-04	.17729E-04
137	.25145E+02	.10809E+01	-.72224E+00	-.37535E-01	-.56170E-01
138	.25145E+02	.12010E+01	-.49749E+00	-.51913E-01	-.12530E+00
139	.25145E+02	.12750E+01	-.25362E+00	-.39944E-01	-.19574E+00
140	.25145E+02	.13000E+01	.14659E-08	.35473E-09	-.24726E+00
141	.27197E+02	.12750E+01	.25362E+00	.57843E-01	-.29080E+00
142	.27197E+02	.12010E+01	.49749E+00	.11539E+00	-.27853E+00
143	.27197E+02	.10809E+01	.72224E+00	.15419E+00	-.23075E+00
144	.27197E+02	.91924E+00	.91924E+00	.17505E+00	-.17505E+00
145	.27197E+02	.72224E+00	.10809E+01	.18984E+00	-.12685E+00
146	.27197E+02	.49749E+00	.12010E+01	.20942E+00	-.86749E-01
147	.27197E+02	.25362E+00	.12750E+01	.24021E+00	-.47784E-01
148	.27197E+02	-.46625E-09	.13000E+01	.28172E+00	.10104E-09
149	.27197E+02	-.25362E+00	.12750E+01	.31289E+00	.62238E-01
150	.27197E+02	-.49749E+00	.12010E+01	.27791E+00	.11513E+00
151	.27197E+02	-.72224E+00	.10809E+01	.15109E+00	.10096E+00
152	.27197E+02	-.91924E+00	.91924E+00	.15768E-04	.13993E-04
153	.27197E+02	-.10809E+01	.72224E+00	-.10095E+00	-.15106E+00
154	.27197E+02	-.12010E+01	.49749E+00	-.11512E+00	-.27789E+00
155	.27197E+02	-.12750E+01	.25362E+00	-.62237E-01	-.31289E+00
156	.27197E+02	-.13000E+01	-.93250E-09	.20208E-09	-.28172E+00
157	.27197E+02	-.12750E+01	-.25362E+00	.47781E-01	-.24019E+00
158	.27197E+02	-.12010E+01	-.49749E+00	.66740E-01	-.20940E+00
159	.27197E+02	-.10809E+01	-.72224E+00	.12583E+00	-.18982E+00
160	.27197E+02	-.91924E+00	-.91924E+00	.17503E+00	-.17503E+00
161	.27197E+02	-.72224E+00	-.10809E+01	.23072E+00	-.15416E+00
162	.27197E+02	-.49749E+00	-.12010E+01	.27852E+00	-.11537E+00
163	.27197E+02	-.25362E+00	-.12750E+01	.29082E+00	-.57847E-01
164	.27197E+02	.13968E-08	-.13000E+01	.25424E+00	.27356E-09
165	.27197E+02	.25362E+00	-.12750E+01	.18614E+00	.37032E-01
166	.27197E+02	.49749E+00	-.12010E+01	.11272E+00	.46701E-01
167	.27197E+02	.72224E+00	-.10809E+01	.49035E-01	.32767E-01
168	.27197E+02	.91924E+00	-.91924E+00	.16423E-04	.15883E-04
169	.27197E+02	.10809E+01	-.72224E+00	.32741E-01	-.48996E-01
170	.27197E+02	.12010E+01	-.49749E+00	-.44641E-01	-.11267E+00
171	.27197E+02	.12750E+01	-.25362E+00	-.37021E-01	-.18608E+00
172	.27197E+02	.13000E+01	.14659E-08	.36467E-09	-.25419E+00
173	.29250E+02	.12750E+01	.25362E+00	.57819E-01	-.29069E+00
174	.29250E+02	.12010E+01	.49749E+00	.12823E+00	-.30958E+00
175	.29250E+02	.10809E+01	.72224E+00	.18263E+00	-.27333E+00
176	.29250E+02	.91924E+00	.91924E+00	.20763E+00	-.20763E+00
177	.29250E+02	.72224E+00	.10809E+01	.21495E+00	-.14362E+00
178	.29250E+02	.49749E+00	.12010E+01	.22129E+00	-.91664E-01
179	.29250E+02	.25362E+00	.12750E+01	.23612E+00	-.46969E-01
180	.29250E+02	-.46625E-09	.13000E+01	.25921E+00	.92966E-10
181	.29250E+02	-.25362E+00	.12750E+01	.27333E+00	.54369E-01
182	.29250E+02	-.49749E+00	.12010E+01	.23805E+00	.98619E-01
183	.29250E+02	-.72224E+00	.10809E+01	.13121E+00	.87680E-01
184	.29250E+02	-.91924E+00	.91924E+00	.12532E-04	.10972E-04
185	.29250E+02	-.10809E+01	.72224E+00	-.07664E-01	-.13119E+00

Figure 16.- Continued.

186	.29250E+02	-.12010E+01	.09749E+00	-.98811E-01	-.23804E+00
187	.29250E+02	-.12750E+01	.25142E+00	-.54366E-01	-.27331E+00
188	.29250E+02	-.13000E+01	-.93250E-09	.18592E-09	-.25910E+00
189	.29250E+02	-.12750E+01	-.25362E+00	.48943E-01	-.23409E+00
190	.29250E+02	-.12010E+01	-.10749E+00	.91346E-01	-.22125E+00
191	.29250E+02	-.10809E+01	-.72224E+00	.14360E+00	-.21491E+00
192	.29250E+02	-.91924E+00	-.91924E+00	.20759E+00	-.20759E+00
193	.29250E+02	-.72224E+00	-.18809E+01	.27331E+00	-.18262E+00
194	.29250E+02	-.49749E+00	-.12110E+01	.30946E+00	-.12824E+00
195	.29250E+02	-.25362E+00	-.12750E+01	.29075E+00	-.57231E-01
196	.29250E+02	.13946E-08	-.13900E+01	.22939E+00	.24683E-09
197	.29250E+02	.25362E+00	-.12750E+01	.15653E+00	.31141E-01
198	.29250E+02	.49749E+00	-.12010E+01	.91194E-01	.37785E-01
199	.29250E+02	.72224E+00	-.10809E+01	.38978E-01	.26047E-01
200	.29250E+02	.91924E+00	-.91924E+00	.11314E-04	.11317E-04
201	.29250E+02	.10809E+01	-.72224E+00	-.26027E-01	-.38949E-01
202	.29250E+02	.12010E+01	-.49749E+00	-.37768E-01	-.91150E-01
203	.29250E+02	.12750E+01	-.25362E+00	-.31130E-01	-.15647E+00
204	.29250E+02	.13000E+01	.18592E-09	.32900E-09	.22933E+00
205	.31303E+02	.12750E+01	.25362E+00	.49546E-01	-.24911E+00
206	.31303E+02	.12010E+01	.49749E+00	.12370E+00	-.29866E+00
207	.31303E+02	.10809E+01	.72224E+00	.20000E+00	-.29940E+00
208	.31303E+02	.91924E+00	.91924E+00	.24551E+00	-.24551E+00
209	.31303E+02	.72224E+00	.10809E+01	.25475E+00	-.17021E+00
210	.31303E+02	.49749E+00	.12010E+01	.24885E+00	-.10308E+00
211	.31303E+02	.25362E+00	.12750E+01	.24583E+00	-.48901E-01
212	.31303E+02	-.48625E-09	.13000E+01	.24957E+00	.89510E-10
213	.31303E+02	-.25362E+00	.12750E+01	.24707E+00	.49147E-01
214	.31303E+02	-.49749E+00	.12010E+01	.20811E+00	.86210E-01
215	.31303E+02	-.72224E+00	.10809E+01	.11440E+00	.76408E-01
216	.31303E+02	-.91924E+00	.91924E+00	.12027E-04	.10661E-04
217	.31303E+02	-.10809E+01	.72224E+00	-.76431E-01	-.11438E+00
218	.31303E+02	-.12010E+01	.49749E+00	-.86203E-01	-.20809E+00
219	.31303E+02	-.12750E+01	.25362E+00	-.49141E-01	-.24704E+00
220	.31303E+02	-.13000E+01	-.93250E-09	.17899E-09	-.24954E+00
221	.31303E+02	-.12750E+01	-.25362E+00	.48891E-01	-.24579E+00
222	.31303E+02	-.12010E+01	-.49749E+00	.10306E+00	-.24880E+00
223	.31303E+02	-.10809E+01	-.72224E+00	.17919E+00	-.25470E+00
224	.31303E+02	-.91924E+00	-.91924E+00	-.24549E+00	-.24549E+00
225	.31303E+02	-.72224E+00	-.10809E+01	.29943E+00	-.20007E+00
226	.31303E+02	-.49749E+00	-.12010E+01	.29872E+00	-.12373E+00
227	.31303E+02	-.25362E+00	-.12750E+01	.29418E+00	-.49560E-01
228	.31303E+02	.13946E-08	-.13000E+01	.18250E+00	.19437E-09
229	.31303E+02	.25362E+00	-.12750E+01	.12022E+00	.23914E-01
230	.31303E+02	.49749E+00	-.12010E+01	.69124E-01	.28600E-01
231	.31303E+02	.72224E+00	-.10809E+01	.29432E-01	.19668E-01
232	.31303E+02	.91924E+00	-.91924E+00	.62402E-05	.59178E-05
233	.31303E+02	.10809E+01	-.72224E+00	-.19657E-01	-.29416E-01
234	.31303E+02	.12010E+01	-.49749E+00	-.28631E-01	-.69101E-01
235	.31303E+02	.12750E+01	-.25362E+00	-.23911E-01	-.12018E+00
236	.31303E+02	.13000E+01	.18592E-09	.28173E-09	-.18244E+00
237	.33355E+02	.12750E+01	.25362E+00	.38101E-01	-.19157E+00
238	.33355E+02	.12010E+01	.49749E+00	.10173E+00	-.24562E+00
239	.33355E+02	.10809E+01	.72224E+00	.18542E+00	-.27750E+00
240	.33355E+02	.91924E+00	.91924E+00	.26061E+00	-.26061E+00
241	.33355E+02	.72224E+00	.10809E+01	.29458E+00	-.19683E+00
242	.33355E+02	.49749E+00	.12010E+01	.28977E+00	-.12003E+00
243	.33355E+02	.25362E+00	.12750E+01	.27176E+00	-.54056E-01
244	.33355E+02	-.48625E-09	.13000E+01	.25552E+00	.91645E-10
245	.33355E+02	-.25362E+00	.12750E+01	.23542E+00	.26831E-01
246	.33355E+02	-.49749E+00	.12010E+01	.18926E+00	.78408E-01
247	.33355E+02	-.72224E+00	.10809E+01	.12231E+00	.68364E-01
248	.33355E+02	-.91924E+00	.91924E+00	.14117E-04	.12498E-04
249	.33355E+02	-.10809E+01	.72224E+00	-.68343E-01	-.10227E+00
250	.33355E+02	-.12010E+01	.49749E+00	-.78393E-01	-.18723E+00

Figure 16.- Continued.

251	.33355E+02	-.12750E+01	.25362E+00	-.46822E-01	-.23538E+00
252	.33355E+02	-.13000E+01	-.93250E-09	.18325E-09	-.25548E+00
253	.33355E+02	-.12750E+01	-.25362E+00	.54046E-01	-.27171E+00
254	.33355E+02	-.12010E+01	-.49749E+00	.12001E+00	-.28973E+00
255	.33355E+02	-.10809E+01	-.72224E+00	.19882E+00	-.29457E+00
256	.33355E+02	-.91924E+00	-.91924E+00	.26064E+00	-.26064E+00
257	.33355E+02	-.72224E+00	-.10809E+01	.27756E+00	-.18548E+00
258	.33355E+02	-.49749E+00	-.12010E+01	.24568E+00	-.10176E+00
259	.33355E+02	-.25362E+00	-.12750E+01	.19162E+00	-.38111E-01
260	.33355E+02	.13486E-08	-.13000E+01	.13693E+00	.14730E-09
261	.33355E+02	.25362E+00	-.12750E+01	.89920E-01	.17890E-01
262	.33355E+02	.49749E+00	-.12010E+01	.51906E-01	.21507E-01
263	.33355E+02	.72224E+00	-.10809E+01	.72193E-01	.14830E-01
264	.33355E+02	.91924E+00	-.91924E+00	.16726E-05	.14291E-05
265	.33355E+02	.10809E+01	-.72224E+00	-.14827E-01	-.22188E-01
266	.33355E+02	.12010E+01	-.49749E+00	-.21503E-01	-.51898E-01
267	.33355E+02	.12750E+01	-.25362E+00	-.17887E-01	-.89904E-01
268	.33355E+02	.13000E+01	.18450E-08	.19641E-09	-.13690E+00

Figure 16.- Concluded.

```

NASA/LANGLEY UPWT PROJ.1126,CONFIGURATION BIT4.
$INPUT
CRP=3.6,SWLEP=30.0,B2=2.34,SWLEV=30.0,CRPV=3.6,B2V=2.34,
NCW=3,MSWR=5,MSWL=5,MSWU=5,MSWD=5,NCRX=1,
ALFAC=14.216,PHI=45.0,FMACH=1.70,
RB=1.3,NRDCR=16,NCWB=3,BIL=3.6,
XWLE=35.4,
XSTART=23.4,
SREF=5.30929,REFL=2.69,
NOLINP=1,NOUT=0,NDRAG=1,NBDYPR=1,NCPDUT=0,NVLIN=1,ITAIL=1,
JCPT=268,
VRTMAX=0.5,
XM=19.5,
NTDAT=1,NCWT=8,
$END
      5      0      0
0.122      0.0      0.0      0.0      0.0      0.0      0.0      -0.141
0.122      0.0      0.0      0.0      0.0      0.0      0.0      -0.141
0.122      0.122      0.0      0.0      0.0      0.0      0.0      -0.141
0.122      0.122      0.0      0.0      0.0      0.0      0.0      -0.141
0.122      0.122      0.0      0.0      0.0      0.0      0.0      -0.141
0.122      0.0      0.0      0.0      0.0      0.0      0.0      -0.141
$BODY
NXBODY=39,LNDBE=7.8,LBODY=39.0,BCODE=2,
$END
      0      0      0      0
      0
ZZZZZZZZZZ

```

Figure 17.- Input for program DEMON2, first sample case, step 6.

NASA/ANGLEY DPMT PROJ. 112A, CONFIGURATION 8170,  
 INPUT

CRP = .36E+01,  
 S-LEP = .3E+02,  
 S+TEP = 0.0,  
 NCW = 3,  
 NSWR = 5,  
 NSWL = 5,  
 ALFAC = .14216E+02,  
 PMI = .45E+02,  
 H2 = .234E+01,  
 FHACH = .17E+01,  
 LVSWP = 0,  
 FAC = .95E+00,  
 NFUNPR = 0,  
 TOLFAC = .1E+01,  
 NSWU = 5,  
 NSWD = 5,  
 S+LEV = .4E+02,  
 S+TEV = 0.0,  
 CRPV = .36E+01,  
 H2V = .234E+01,  
 NCRX = 1,  
 WH = .13E+01,  
 RA = .13E+01,  
 FRATIO = .1E+01,  
 NHOCW = 16,  
 DFIR = 0.0,  
 DELI = 0.0,  
 DELU = 0.0,  
 DELD = 0.0,

SREF = .530929E+01,  
 REFL = .289E+01,  
 PHIDIM = 0.0,  
 THETIT = 0.0,  
 XMLE = .354E+02,  
 NOLINP = 1,  
 NOUT = 0,  
 NPR = 0,  
 NDRAG = 1,  
 NVRTX = 0,  
 NPRESS = 0,  
 VRTMAX = .5E+00,  
 NCWB = 3,  
 NAGAIN = 0,  
 HIL = .36E+01,  
 ITAIL = 1,  
 NVRTPL = 0,  
 NHQVPR = 1,  
 NTPR = 0,  
 VTDAT = 1,  
 NCMT = 8,  
 NCPHIT = 0,  
 NVLIN = 1,  
 XSTART = .234E+02,  
 JCPT = 268,  
 FKLE = .5E+00,  
 FKSE = .5E+00,  
 XM = .195E+02,  
 ZM = 0.0,  
 SEND

Figure 18.- Output of program DEMON2, first sample case, step 6.

## WING GEOMETRY

TIP CHORD = 2.24000  
 ROOT CHORD = 3.60000  
 WING SEMISPAN = 2.34000  
 LEADING EDGE SWEEP = 30.00000 DEGREES  
 TRAILING EDGE SWEEP = 0.00000 DEGREES

## FLOW CONDITIONS

MACH = 1.70000 ALPHACH = 14.21600 PMT = 25.00000 ALPHA = 10.00010 BETA = 10.00010

COPT = 3.60000  
 CRPTV = 3.60000

## WING THICKNESS INPUT DATA

SPANWISE LOCATIONS OF PANEL SIDE EDGES AND SWEEP ANGLES  
 OF WING SECTION TO THE LEFT

I	SPANWISE LOCATION FEET	LE SWEEP DEGREES	TE SWEEP DEGREES
---	------------------------------	---------------------	---------------------

## RIGHT WING SURFACE

1	1.30000	0.00000	0.00000
2	1.76000	30.00000	0.00000
3	2.23000	30.00000	0.00000
4	2.70000	30.00000	0.00000
5	3.17200	30.00000	0.00000
6	3.64000	30.00000	0.00000

40 THICKNESS PANELS ARE TO BE Laid OUT  
 5 CHORDWISE ROWS WITH 8 IN EACH ROW

## UPPER WING SURFACE

1	1.30000	0.00000	0.00000
2	1.76000	30.00000	0.00000
3	2.23000	30.00000	0.00000
4	2.70000	30.00000	0.00000
5	3.17200	30.00000	0.00000
6	3.64000	30.00000	0.00000

40 THICKNESS PANELS ARE TO BE Laid OUT  
 5 CHORDWISE ROWS WITH 8 IN EACH ROW

INPUT VALUES OF THE LOCAL SURFACE SLOPE OF THE THICKNESS  
DISTRIBUTION, FOR EACH CHORDWISE ROW THE FIRST VALUE  
IS FOR THE PANEL NEAREST THE LEADING EDGE

# RIGHT WING SURFACE

ROW	SLOPES							
1	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
2	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
3	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
4	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
5	.12200	.12200	0.00000	0.00000	0.00000	0.00000	-.14100	-.14100

# UPPER WING SURFACE

ROW	SLOPES							
1	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
2	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
3	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
4	.12200	.12200	0.00000	0.00000	0.00000	0.00000	0.00000	-.14100
5	.12200	.12200	0.00000	0.00000	0.00000	0.00000	-.14100	-.14100

SHOBY

SHOBY = 39.

LOOSE = .78E+01

LOODY = .39E+02.

RCODE = 2.

SEAD

PHYSICAL DIMENSIONS OF BODY AND LINE SINGULARITY STRENGTHS REPRESENTING THE BODY AT MACH= 1.7000

ALFAC= 14.2140

X	Y	TX	Y(I)	TC(I)
1 0.0000	-.42433E-13	.34286	.10092	.39463E-01
2 1.0263	.32439	.29353	-.40121E-01	-.10956E-01
3 2.0526	.60316	.24411	-.25012E-01	-.62846E-02
4 3.0789	.85207	.20020	-.23274E-01	-.81381E-02
5 4.1053	1.0145	.15547	-.18881E-01	-.74517E-02
6 5.1316	1.1515	.11164	-.15477E-01	-.75496E-02
7 6.1579	1.2439	.06039E-01	-.11952E-01	-.73645E-02
8 7.1842	1.2921	.25413E-01	-.44169E-02	-.70718E-02
9 8.2105	1.3000	0.	.31078E-01	-.28112E-02
10 9.2368	1.3000	0.	.35294E-02	-.47754E-02
11 10.2632	1.3000	0.	.34046E-02	-.19940E-02
12 11.2895	1.3000	0.	.9.5023	.14132E-02
13 12.3158	1.3000	0.	10.529	.93609E-03
14 13.3421	1.3000	0.	11.555	.55066E-03
15 14.3684	1.3000	0.	12.581	.36257E-03
16 15.3947	1.3000	0.	13.608	.23850E-03
17 16.4211	1.3000	0.	14.634	.16227E-03
18 17.4474	1.3000	0.	15.660	.11249E-03

Figure 18.- Continued.



19	18.4737	1.3000	0.	36.444	.74559E-04	-.67235E-04
20	19.5000	1.3000	0.	17.713	.57218E-04	-.10624E-03
21	20.5265	1.3000	0.	18.739	.41794E-04	-.10993E-03
22	21.5526	1.3000	0.	19.765	.30461E-04	-.95708E-04
23	22.5789	1.3000	0.	20.792	.23236E-04	-.75192E-04
24	23.6053	1.3000	0.	21.818	.17450E-04	-.54633E-04
25	24.6316	1.3000	0.	22.844	.13558E-04	-.37078E-04
26	25.6579	1.3000	0.	23.871	.10525E-04	-.25532E-04
27	26.6842	1.3000	0.	24.897	.82509E-05	-.13675E-04
28	27.7105	1.3000	0.	25.923	.65280E-05	-.74711E-05
29	28.7368	1.3000	0.	26.950	.52100E-05	-.35327E-05
30	29.7632	1.3000	0.	27.976	.41922E-05	-.13202E-05
31	30.7895	1.3000	0.	29.002	.33493E-05	-.22844E-06
32	31.8158	1.3000	0.	30.029	.27766E-05	.19378E-06
33	32.8421	1.3000	0.	31.055	.22835E-05	.25675E-06
34	33.8684	1.3000	0.	32.081	.18903E-05	.15784E-06
35	34.8947	1.3000	0.	33.108	.15745E-05	.11691E-07
36	35.9211	1.3000	0.	34.134	.13191E-05	-.12295E-06
37	36.9474	1.3000	0.	35.160	.11112E-05	-.22221E-06
38	37.9737	1.3000	0.	36.186	.94102E-06	-.28148E-06
39	39.0000	1.3000	0.	37.213	0.	0.

## POINT COORDINATES AND PERTURBATION VELOCITIES CALCULATED BY PROGRAM VPATHE

IC	XCP	YCP	ZCP	VVEL(IC)	WVEL(IC)
1	36.63100	1.53100	0.00000	.22541E-01	-.74105E-01
2	37.78700	1.53100	0.00000	.19927E-01	-.67006E-01
3	38.94200	1.53100	0.00000	.17748E-01	-.61175E-01
4	39.81800	1.99870	0.00000	.41619E-01	-.45614E-01
5	37.88100	1.99870	0.00000	.37375E-01	-.42293E-01
6	38.94700	1.99870	0.00000	.34459E-01	-.39479E-01
7	37.00000	2.46640	0.00000	.44308E-01	-.76003E-01
8	37.97600	2.46640	0.00000	.40555E-01	-.25016E-01
9	38.95100	2.46640	0.00000	.37344E-01	-.24108E-01
10	37.18500	2.93400	0.00000	.40999E-01	-.13556E-01
11	38.07000	2.93400	0.00000	.38258E-01	-.13699E-01
12	38.95600	2.93400	0.00000	.35851E-01	-.13763E-01
13	37.36900	3.40160	0.00000	.36017E-01	-.60080E-02
14	38.16500	3.40160	0.00000	.34184E-01	-.65582E-02
15	38.96000	3.40160	0.00000	.32528E-01	-.70041E-02
16	36.63100	-1.53100	0.00000	.25922E-01	-.24335E+00
17	37.78700	-1.53100	0.00000	.24109E-01	-.25303E+00
18	38.94200	-1.53100	0.00000	.19507E-01	-.25401E+00
19	36.81800	-1.99870	0.00000	.51219E-01	-.17161E+00
20	37.88100	-1.99870	0.00000	.53088E-01	-.18545E+00
21	38.94700	-1.99870	0.00000	.48996E-01	-.19858E+00
22	37.00000	-2.46640	0.00000	.59243E-01	-.91572E-01
23	37.97600	-2.46640	0.00000	.74149E-01	-.10455E+00
24	38.95100	-2.46640	0.00000	.84330E-01	-.12168E+00
25	37.18500	-2.93400	0.00000	.56495E-01	-.21821E-01
26	38.07000	-2.93400	0.00000	.75918E-01	-.23056E-01
27	38.95600	-2.93400	0.00000	.98548E-01	-.29258E-01
28	37.36900	-3.40160	0.00000	.43943E-01	.14325E-01
29	38.16500	-3.40160	0.00000	.57888E-01	.19927E-01
30	38.96000	-3.40160	0.00000	.74961E-01	.25394E-01
31	36.63100	.00000	1.53100	.24338E+00	-.25911E-01
32	37.78700	.00000	1.53100	.25305E+00	-.24092E-01

Figure 18.- Continued.

33	34,94200	.00000	1,53100	.25802E+00	-.10486E-01
34	34,94100	.00000	1,99870	.17145E+00	-.41210E-01
35	37,88100	.00000	1,99870	.18540E+00	-.53383E-01
36	34,94700	.00000	1,99870	.19881E+00	-.48956E-01
37	37,00000	.00000	2,46640	.91618E-01	-.59462E-01
38	37,97800	.00000	2,46640	.10360E+00	-.74159E-01
39	34,95100	.00000	2,46640	.12174E+00	-.84317E-01
40	37,14500	.00000	2,93400	.21847E-01	-.56537E-01
41	38,07000	.00000	2,93400	.23094E-01	-.75960E-01
42	38,95600	.00000	2,93400	.29311E-01	-.98810E-01
43	37,36900	.00000	3,40160	-.14321E-01	-.44031E-01
44	34,16500	.00000	3,40160	-.19920E-01	-.57935E-01
45	34,96000	.00000	3,40160	-.25385E-01	-.75025E-01
46	36,63100	-.00000	-1,53100	.74107E-01	-.22546E-01
47	37,78700	-.00000	-1,53100	.67006E-01	-.19931E-01
48	34,94200	-.00000	-1,53100	.61173E-01	-.17801E-01
49	36,81600	-.00000	-1,99870	.45611E-01	-.41626E-01
50	37,88100	-.00000	-1,99870	.42284E-01	-.37381E-01
51	38,94700	-.00000	-1,99870	.39475E-01	-.33864E-01
52	37,00000	-.00000	-2,46640	.25997E-01	-.44314E-01
53	37,97600	-.00000	-2,46640	.25009E-01	-.40561E-01
54	34,95100	-.00000	-2,46640	.24101E-01	-.37368E-01
55	37,14500	-.00000	-2,93400	.13548E-01	-.41002E-01
56	34,07000	-.00000	-2,93400	.13692E-01	-.38261E-01
57	34,95600	-.00000	-2,93400	.13746E-01	-.35854E-01
58	37,36900	-.00000	-3,40160	.60006E-02	-.36018E-01
59	34,16500	-.00000	-3,40160	.65510E-02	-.34185E-01
60	34,96000	-.00000	-3,40160	.70012E-02	-.32529E-01
61	36,54000	1,25050	.24874	.21274E-01	-.12874E+00
62	36,54000	1,06010	.70836	.12787E+00	-.20246E+00
63	36,54000	.70836	1,06010	.28783E+00	-.19570E+00
64	36,54000	.24874	1,25050	.32388E+00	-.60836E-01
65	36,54000	-.24874	1,25050	.24801E+00	.53505E-01
66	36,54000	-.70836	1,06010	.91774E-01	.73741E-01
67	36,54000	-1,06010	.70836	-.73710E-01	-.91728E-01
68	36,54000	-1,25050	.24874	-.53496E-01	-.24796E+00
69	36,54000	-1,25050	-.24874	.60831E-01	-.32364E+00
70	36,54000	-1,06010	-.70836	.19573E+00	-.28788E+00
71	36,54000	-.70836	-1,06010	.20250E+00	-.12770E+00
72	36,54000	-.24874	-1,25050	.12875E+00	-.21275E-01
73	36,54000	.24874	-1,25050	.61400E-01	.14886E-01
74	36,54000	.70836	-1,06010	.14602E-01	.12062E-01
75	36,54000	1,06010	-.70836	-.12066E-01	-.14607E-01
76	36,54000	1,25050	-.24874	-.14886E-01	-.61401E-01
77	37,74000	1,25050	.24874	.19040E-01	-.11463E+00
78	37,74000	1,06010	.70836	.11255E+00	-.17854E+00
79	37,74000	.70836	1,06010	.26421E+00	-.18126E+00
80	37,74000	.24874	1,25050	.32649E+00	-.62557E-01
81	37,74000	-.24874	1,25050	.25853E+00	.55706E-01
82	37,74000	-.70836	1,06010	.95893E-01	.77032E-01
83	37,74000	-1,06010	.70836	-.78997E-01	-.95401E-01
84	37,74000	-1,25050	.24874	-.55899E-01	-.25849E+00
85	37,74000	-1,25050	-.24874	.62555E-01	-.32650E+00
86	37,74000	-1,06010	-.70836	.18130E+00	-.26427E+00
87	37,74000	-.70836	-1,06010	.17862E+00	-.11257E+00
88	37,74000	-.24874	-1,25050	.11484E+00	-.19041E-01
89	37,74000	.24874	-1,25050	.55514E-01	.13401E-01
90	37,74000	.70836	-1,06010	.33307E-01	.10944E-01

Figure 18.- Continued.

91	37,74000	1,06010	-.70836	-.10001E+01	-.13314E+01
92	37,74000	1,25050	-.24674	-.13401E+01	-.55518E+01
93	38,94000	1,25050	-.24674	-.17227E+01	-.10318E+00
94	38,94000	1,06010	-.70836	-.99922E+01	-.15445E+00
95	38,94000	-.70836	1,06010	-.23901E+00	-.16495E+00
96	38,94000	-.24674	1,25050	-.31998E+00	-.42611E+01
97	38,94000	-.24674	1,25050	-.26666E+00	-.57132E+01
98	38,94000	-.70836	1,06010	-.10024E+00	-.80495E+01
99	38,94000	-1,06010	-.70836	-.80495E+01	-.10022E+00
100	38,94000	-1,25050	-.24674	-.57127E+01	-.26662E+00
101	38,94000	-1,25050	-.24674	-.82613E+01	-.32000E+00
102	38,94000	-1,06010	-.70836	-.16490E+00	-.23906E+00
103	38,94000	-.70836	-1,06010	-.15804E+00	-.49937E+01
104	38,94000	-.24674	-1,25050	-.10318E+00	-.17227E+01
105	38,94000	-.24674	-1,25050	-.50709E+01	-.12211E+01
106	38,94000	-.70836	-1,06010	-.12245E+01	-.10108E+01
107	38,94000	1,06010	-.70836	-.10113E+01	-.12252E+01
108	38,94000	1,25050	-.24674	-.12212E+01	-.50714E+01
109	25,14500	1,27500	-.25362	-.51894E+01	-.26088E+00
110	25,14500	1,20100	-.49749	-.98361E+01	-.23745E+00
111	25,14500	1,08090	-.72224	-.13105E+00	-.19612E+00
112	25,14500	-.91924	-.91924	-.15447E+00	-.15447E+00
113	25,14500	-.72224	1,08090	-.17758E+00	-.11865E+00
114	25,14500	-.49749	1,20100	-.20820E+00	-.86245E+01
115	25,14500	-.25362	1,27500	-.25233E+00	-.50196E+01
116	25,14500	-.00000	1,30000	-.11195E+00	-.11188E+09
117	25,14500	-.25362	1,27500	-.35000E+00	-.72225E+01
118	25,14500	-.49749	1,20100	-.32579E+00	-.13497E+00
119	25,14500	-.72224	1,08090	-.17191E+00	-.11488E+00
120	25,14500	-.91924	-.91924	-.21260E+00	-.19278E+04
121	25,14500	-1,08090	-.72224	-.11485E+00	-.17187E+00
122	25,14500	-1,20100	-.49749	-.13496E+00	-.12577E+00
123	25,14500	-1,27500	-.25362	-.72224E+01	-.35000E+00
124	25,14500	-1,30000	-.00000	-.23377E+00	-.31196E+00
125	25,14500	-1,27500	-.25362	-.50194E+01	-.25232E+00
126	25,14500	-1,20100	-.49749	-.86241E+01	-.20819E+00
127	25,14500	-1,08090	-.72224	-.11865E+00	-.17757E+00
128	25,14500	-.91924	-.91924	-.15445E+00	-.15445E+00
129	25,14500	-.72224	1,08090	-.19610E+00	-.13103E+00
130	25,14500	-.49749	1,20100	-.23743E+00	-.98352E+01
131	25,14500	-.25362	1,27500	-.26088E+00	-.51893E+01
132	25,14500	-.00000	1,30000	-.24729E+00	-.26088E+09
133	25,14500	-.25362	1,27500	-.19580E+00	-.38953E+01
134	25,14500	-.49749	1,20100	-.12534E+00	-.51932E+01
135	25,14500	-.72224	1,08090	-.56213E+01	-.37564E+01
136	25,14500	-.91924	-.91924	-.18550E+04	-.17724E+04
137	25,14500	1,08090	-.72224	-.17535E+01	-.56170E+01
138	25,14500	1,20100	-.49749	-.51913E+01	-.12530E+00
139	25,14500	1,27500	-.25362	-.38944E+01	-.19576E+00
140	25,14500	1,30000	-.00000	-.35473E+00	-.24726E+00
141	27,19700	1,27500	-.25362	-.57843E+01	-.29080E+00
142	27,19700	1,20100	-.49749	-.11538E+00	-.27853E+00
143	27,19700	1,08090	-.72224	-.15419E+00	-.23075E+00
144	27,19700	-.91924	-.91924	-.17505E+00	-.17505E+00
145	27,19700	-.72224	1,08090	-.18940E+00	-.12885E+00
146	27,19700	-.49749	1,20100	-.20942E+00	-.86749E+01
147	27,19700	-.25362	1,27500	-.24021E+00	-.47784E+01
148	27,19700	-.00000	1,30000	-.28172E+00	-.10104E+09

Figure 18.- Continued.

149	27,19700	-.25362	1,27500	.31280F+00	.62238E-01
150	27,19700	-.49749	1,20100	.27791E+00	.11515E+00
151	27,19700	-.72224	1,08090	.15109F+00	.10096E+00
152	27,19700	-.91924	.91924	.15788F+00	.13993E+00
153	27,19700	-1,08090	.72224	-.10095F+00	-.15106E+00
154	27,19700	-1,20100	.49749	-.11512F+00	-.27789E+00
155	27,19700	-1,27500	.25362	-.62237E-01	-.31289E+00
156	27,19700	-1,40000	-.00000	.20208E+09	-.28172E+00
157	27,19700	-1,27500	-.25362	.47781F+01	-.24019E+00
158	27,19700	-1,20100	-.49749	.86740E+01	-.20940E+00
159	27,19700	-1,08090	-.72224	.12683E+00	-.18982E+00
160	27,19700	-.91924	-.91924	.17503E+00	-.17503E+00
161	27,19700	-.72224	-1,08090	.23072F+00	-.15416E+00
162	27,19700	-.49749	-1,20100	.27852F+00	-.11537E+00
163	27,19700	-.25362	-1,27500	.29002F+00	-.57847E+01
164	27,19700	.00000	-1,30000	.25424E+00	.27356E+09
165	27,19700	.25362	-1,27500	.18610F+00	.17032E-01
166	27,19700	.49749	-1,20100	.11272F+00	.46701F-01
167	27,19700	.72224	-1,08090	.49035F+01	.32767E-01
168	27,19700	.91924	-.91924	.16423E+04	.15883E-04
169	27,19700	1,08090	-.72224	-.32781F+01	-.48996E+01
170	27,19700	1,20100	-.49749	-.46681F+01	-.11267E+00
171	27,19700	1,27500	-.25362	-.37021E+01	-.18608E+00
172	27,19700	1,30000	.00000	.36487E+09	-.25419E+00
173	29,25000	-1,27500	.25362	.57819E+01	-.29069E+00
174	29,25000	-1,20100	.49749	.12823E+00	-.30958E+00
175	29,25000	-1,08090	.72224	.18283E+00	-.27333E+00
176	29,25000	-.91924	.91924	.20783E+00	-.20783E+00
177	29,25000	.72224	1,08090	.21895E+00	-.14362E+00
178	29,25000	.49749	1,20100	.22124E+00	-.91664E-01
179	29,25000	.25362	1,27500	.23612F+00	-.48969E-01
180	29,25000	.00000	1,30000	.25921F+00	.92466E-10
181	29,25000	-.25362	1,27500	.27333E+00	.54364E-01
182	29,25000	-.49749	1,20100	.23805F+00	.98819E-01
183	29,25000	-.72224	1,08090	.13121E+00	.87680E-01
184	29,25000	-.91924	.91924	.12532E+04	.10972E-04
185	29,25000	-1,08090	.72224	.87684E+01	-.13119E+00
186	29,25000	-1,20100	.49749	.95611E+01	-.23800E+00
187	29,25000	-1,27500	.25362	-.54388E+01	-.27431F+00
188	29,25000	-1,30000	-.00000	.18492F+09	-.25019E+00
189	29,25000	-1,27500	-.25362	.48983E+01	-.23809E+00
190	29,25000	-1,20100	-.49749	.91688E+01	-.22125E+00
191	29,25000	-1,08090	-.72224	.14480E+00	-.21491F+00
192	29,25000	-.91924	-.91924	.20759E+00	-.20759E+00
193	29,25000	-.72224	-1,08090	.27331E+00	-.18262F+00
194	29,25000	-.49749	-1,20100	.30980E+00	-.12824E+00
195	29,25000	-.25362	-1,27500	.29075E+00	-.57831E-01
196	29,25000	.00000	-1,30000	.22939E+00	.24683F+09
197	29,25000	.25362	-1,27500	.15851F+00	.31141F-01
198	29,25000	.49749	-1,20100	.91104E+01	.37785F-01
199	29,25000	.72224	-1,08090	.38978E+11	.28807F-01
200	29,25000	.91924	-.91924	.11744F+04	.11317F+04
201	29,25000	1,08090	-.72224	-.26027E+01	-.38949E-01
202	29,25000	1,20100	-.49749	-.37188F+01	-.91154E-01
203	29,25000	1,27500	-.25362	-.11110F+01	-.15847E+00
204	29,25000	1,30000	.00000	.32900E+09	-.22933E+00
205	31,30300	-1,27500	.25362	.49544E+01	-.24911E+00
206	31,30300	-1,20100	.49749	.12370E+00	-.29865E+00
207	31,30300	-1,08090	.72224	.20006E+00	-.29940E+00

Figure 18.- Continued.

200	31,30300	.91924	.41924	.20551E+00	-.20551E+00
201	31,30300	.72224	1.08090	.25075E+00	-.17021E+00
210	31,30300	.49749	1.20100	.24845E+00	-.10308E+00
211	31,30300	.25362	1.27500	.24583E+00	-.08900E+01
212	31,30300	.00000	1.30000	.24957E+00	.80510E-10
213	31,30300	-.25362	1.27500	.24707E+00	.49147E-01
214	31,30300	-.49749	1.20100	.20811E+00	.88214E-01
215	31,30300	-.72224	1.08090	.11400E+00	.76008E-01
216	31,30300	-.91924	.91924	.12027E+00	.10661E-04
217	31,30300	-1.08090	.72224	-.76431E-01	-.11438E+00
218	31,30300	-1.20100	.49749	-.66203E-01	-.20808E+00
219	31,30300	-1.27500	.25362	-.49141E-01	-.24704E+00
220	31,30300	-1.30000	.00000	.17809E-09	-.24954E+00
221	31,30300	-1.27500	-.25362	.48891E-01	-.24579E+00
222	31,30300	-1.20100	-.49749	.10306E+00	-.24880E+00
223	31,30300	-1.08090	-.72224	.17019E+00	-.25470E+00
224	31,30300	-.91924	-.91924	.24549E+00	-.24549E+00
225	31,30300	-.72224	-1.08090	.29903E+00	-.20007E+00
226	31,30300	-.49749	-1.20100	.29872E+00	-.12373E+00
227	31,30300	-.25362	-1.27500	.24918E+00	-.49560E-01
228	31,30300	.00000	-1.30000	.18250E+00	.19837E-09
229	31,30300	.25362	-1.27500	.12022E+00	.23914E-01
230	31,30300	.49749	-1.20100	.69124E-01	.28440E-01
231	31,30300	.72224	-1.08090	.29432E-01	.19868E-01
232	31,30300	.91924	-.91924	.62402E-05	.59178E-05
233	31,30300	1.08090	-.72224	-.19657E-01	-.29416E-01
234	31,30300	1.20100	-.49749	-.28631E-01	-.69101E-01
235	31,30300	1.27500	-.25362	-.23911E-01	-.12018E+00
236	31,30300	1.30000	.00000	.26173E-09	-.18244E+00
237	31,35500	1.27500	.25362	.38101E-01	-.19157E+00
238	31,35500	1.20100	.49749	.10176E+00	-.24562E+00
239	31,35500	1.08090	.72224	.18542E+00	-.27750E+00
240	31,35500	.91924	.41924	.26081E+00	-.26081E+00
241	31,35500	.72224	1.08090	.29458E+00	-.10683E+00
242	31,35500	.49749	1.20100	.28977E+00	-.12003E+00
243	31,35500	.25362	1.27500	.27176E+00	-.50059E-01
244	31,35500	.00000	1.30000	.25552E+00	.91845E-10
245	31,35500	-.25362	1.27500	.23542E+00	.46831E-01
246	31,35500	-.49749	1.20100	.18926E+00	.78408E-01
247	31,35500	-.72224	1.08090	.10231E+00	.68364E-01
248	31,35500	-.91924	.91924	.14117E-04	.12844E-04
249	31,35500	-1.08090	.72224	-.68403E-01	-.10227E+00
250	31,35500	-1.20100	.49749	-.78393E-01	-.18923E+00
251	31,35500	-1.27500	.25362	-.46492E-01	-.23538E+00
252	31,35500	-1.30000	.00000	.18325E-09	-.25548E+00
253	31,35500	-1.27500	-.25362	.54004E-01	-.27171E+00
254	31,35500	-1.20100	-.49749	.12001E+00	-.28973E+00
255	31,35500	-1.08090	-.72224	.19642E+00	-.29457E+00
256	31,35500	-.91924	-.91924	.26080E+00	-.26080E+00
257	31,35500	-.72224	-1.08090	.27756E+00	-.18540E+00
258	31,35500	-.49749	-1.20100	.24548E+00	-.10176E+00
259	31,35500	-.25362	-1.27500	.19182E+00	-.38111E-01
260	31,35500	.00000	-1.30000	.13894E+00	.14734E-09
261	31,35500	.25362	-1.27500	.69920E-01	.17890E-01
262	31,35500	.49749	-1.20100	.51906E-01	.21507E-01
263	31,35500	.72224	-1.08090	.22193E-01	.14830E-01
264	31,35500	.91924	-.91924	.16726E-05	.14291E-05
265	31,35500	1.08090	-.72224	-.14827E-01	-.22188E-01

Figure 18.- Continued.

26A	33.35500	1.20100	-.49749	-.21503E-01	-.51898E-01
267	33.35500	1.27500	-.25362	-.17887E-01	-.89904E-01
26A	33.35500	1.40000	.00000	.19641E-09	-.13690E+00

PRESSURE COEFFICIENTS AT POINTS ON BODY MERIDIANS

J	THETA, DEG.	XR	YR	ZR	UTOT	VTOT	WTOT	CP,LIN.	CP,HEMN.	DR/DX	P/PINF, HEMN.	P/PINF, LIN.
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TOTAL NUMBER OF PRESSURE POINTS,JCPT= 26A

BODY PING= 13

1	11.25000	25.14474	1.27502	.25362	.00178	.14660	-.03041	-.00356	.03653	0.00000	1.07390	.99279
2	22.50000	25.14474	1.20104	.49749	.00176	.09743	.01196	-.00352	.01690	0.00000	1.03419	.99289
3	33.75000	25.14474	1.08091	.72224	.00173	.03527	.03435	-.00347	-.00544	0.00000	.98899	.99299
4	45.00000	25.14474	.91924	.91924	.00171	-.02205	.02205	-.00342	-.01932	0.00000	.94091	.99309
5	56.25000	25.14474	.72224	1.08091	.00168	-.05289	-.02288	-.00337	-.01680	0.00000	.96602	.99319
6	67.50000	25.14474	.49749	1.20104	.00166	-.04121	-.08571	-.00332	.00320	0.00000	1.00647	.99329
7	78.75000	25.14474	.25362	1.27502	.00164	.02186	-.14490	-.00327	.05408	0.00000	1.06494	.99338
8	90.00000	25.14474	-.00000	1.30000	.00162	.13543	-.17544	-.00323	.05799	0.00000	1.11731	.99346
9	101.25000	25.14474	-.25362	1.27502	.00160	.25422	-.15717	-.00320	.05231	0.00000	1.16582	.99353
10	112.50000	25.14474	-.49749	1.20104	.00159	.32523	-.11337	-.00317	.03129	0.00000	1.06131	.99358
11	123.75000	25.14474	-.72224	1.08091	.00158	.26661	-.11451	-.00316	.04659	0.00000	1.09426	.99361
12	135.00000	25.14474	-.91924	.91924	.00158	.17547	-.17543	-.00315	.05465	0.00000	1.12047	.99362
13	146.25000	25.14474	-1.08091	.72224	.00158	.11454	-.26657	-.00316	.04660	0.00000	1.09428	.99361
14	157.50000	25.14474	-1.20104	.49749	.00159	.11335	-.32523	-.00317	.03130	0.00000	1.06532	.99358
15	168.75000	25.14474	-1.27502	.25362	.00160	.15717	-.25422	-.00320	.05231	0.00000	1.10582	.99353
16	180.00000	25.14474	-1.30000	-.00000	.00162	.17544	-.13544	-.00323	.05799	0.00000	1.11731	.99346
17	191.25000	25.14474	-1.27502	-.25362	.00164	.14490	-.02185	-.00327	.03407	0.00000	1.06494	.99338
18	202.50000	25.14474	-1.20104	-.49749	.00166	.08571	.04122	-.00332	.00320	0.00000	1.00646	.99329
19	213.75000	25.14474	-1.08091	-.72224	.00168	.02287	.05289	-.00337	-.01680	0.00000	.96600	.99319
20	225.00000	25.14474	-.91924	-.91924	.00171	-.02207	.02207	-.00342	-.01934	0.00000	.94088	.99309
21	236.25000	25.14474	-.72224	-1.08091	.00173	-.03437	-.03525	-.00347	-.00544	0.00000	.98896	.99299
22	247.50000	25.14474	-.49749	-1.20104	.00176	-.01198	-.09782	-.00352	.01690	0.00000	1.03417	.99289
23	258.75000	25.14474	-.25362	-1.27502	.00178	.03041	-.14660	-.00356	.03653	0.00000	1.07390	.99279
24	270.00000	25.14474	.00000	-1.30000	.00180	.07077	-.17544	-.00360	.04779	0.00000	1.09668	.99271
25	281.25000	25.14474	.25362	-1.27502	.00182	.10002	-.19044	-.00363	.05299	0.00000	1.10720	.99265
26	292.50000	25.14474	.49749	-1.20104	.00183	.12480	-.19641	-.00366	.05598	0.00000	1.11324	.99260
27	303.75000	25.14474	.72224	-1.08091	.00184	.15092	-.19183	-.00367	.05819	0.00000	1.11772	.99257
28	315.00000	25.14474	.91924	-.91924	.00184	.17546	-.17543	-.00368	.05910	0.00000	1.11955	.99256
29	326.25000	25.14474	1.08091	-.72224	.00184	.19186	-.15087	-.00367	.05819	0.00000	1.11771	.99257
30	337.50000	25.14474	1.20104	-.49749	.00183	.19643	-.12476	-.00366	.05598	0.00000	1.11324	.99260
31	348.75000	25.14474	1.27502	-.25362	.00182	.19045	-.09498	-.00363	.05299	0.00000	1.10719	.99265
32	360.00000	25.14474	1.30000	.00000	.00180	.17544	-.07074	-.00360	.04779	0.00000	1.09667	.99271

BODY RTNG= 14

1	11.25000	27.19737	1.27502	.25362	.00187	.15258	-.06048	-.00293	.04564	0.00000	1.09233	.99406
2	22.50000	27.19737	1.20104	.49749	.00185	.11491	-.02428	-.00290	.03401	0.00000	1.06880	.99414
3	33.75000	27.19737	1.08091	.72224	.00183	.05851	-.00043	-.00286	.01443	0.00000	1.02918	.99422
4	45.00000	27.19737	.91924	.91924	.00181	-.00134	.00134	-.00281	-.00365	0.00000	.99261	.99431

Figure 18.- Continued.

5	56,25000	27,19737	.72224	1,08091	.00134	.04000	-.03117	-.00277	-.00084	0,00000	.99285	.99000
6	67,50000	27,19737	.49749	1,20104	.00136	-.03983	-.08628	-.00273	.00447	0,00000	1,00904	.99000
7	78,75000	27,19737	.25362	1,27502	.00135	.00989	-.14252	-.00269	.03057	0,00000	1,00183	.99000
8	90,00000	27,19737	-.00000	1,30000	.00133	.10533	-.17544	-.00266	.05513	0,00000	1,11152	.99000
9	101,25000	27,19737	-.25362	1,27502	.00132	.21721	-.16714	-.00263	.05810	0,00000	1,11755	.99000
10	112,50000	27,19737	-.49749	1,20104	.00130	.27744	-.13318	-.00261	.04687	0,00000	1,09043	.99000
11	123,75000	27,19737	-.72224	1,08091	.00130	.24582	-.12801	-.00260	.05241	0,00000	1,10602	.99000
12	135,00000	27,19737	-.91924	.91924	.00130	.17546	-.17543	-.00259	.06024	0,00000	1,12186	.99000
13	146,25000	27,19737	-1,08091	.72224	.00130	.12802	-.24579	-.00260	.05241	0,00000	1,10603	.99000
14	157,50000	27,19737	-1,20104	.49749	.00130	.13319	-.27742	-.00261	.04688	0,00000	1,09044	.99000
15	168,75000	27,19737	-1,27502	.25362	.00132	.16714	-.21721	-.00263	.05810	0,00000	1,11755	.99000
16	180,00000	27,19737	-1,30000	-.00000	.00133	.17544	-.10533	-.00266	.05513	0,00000	1,11152	.99000
17	191,25000	27,19737	-1,27502	-.25362	.00135	.14251	-.00989	-.00269	.03056	0,00000	1,00182	.99000
18	202,50000	27,19737	-1,20104	-.49749	.00136	.08627	.03985	-.00273	.00446	0,00000	1,00902	.99000
19	213,75000	27,19737	-1,08091	-.72224	.00134	.03115	.04050	-.00277	-.00849	0,00000	.99285	.99000
20	225,00000	27,19737	-.91924	-.91924	.00141	-.00136	.00136	-.00281	-.00367	0,00000	.99295	.99000
21	236,25000	27,19737	-.72224	-1,08091	.00143	.00000	-.05804	-.00286	.01441	0,00000	1,02911	.99000
22	247,50000	27,19737	-.49749	-1,20104	.00145	.02927	-.11490	-.00290	.03400	0,00000	1,08879	.99000
23	258,75000	27,19737	-.25362	-1,27502	.00147	.06050	-.15258	-.00293	.04565	0,00000	1,09234	.99000
24	270,00000	27,19737	.00000	-1,30000	.00148	.07785	-.17544	-.00297	.04995	0,00000	1,10106	.99000
25	281,25000	27,19737	.25362	-1,27502	.00150	.09046	-.19234	-.00300	.05198	0,00000	1,10515	.99000
26	292,50000	27,19737	.49749	-1,20104	.00151	.11225	-.20161	-.00302	.05488	0,00000	1,11112	.99000
27	303,75000	27,19737	.72224	-1,08091	.00151	.14377	-.19661	-.00303	.05825	0,00000	1,11744	.99000
28	315,00000	27,19737	.91924	-.91924	.00152	.17546	-.17543	-.00303	.05978	0,00000	1,12093	.99000
29	326,25000	27,19737	1,08091	-.72224	.00151	.19663	-.14373	-.00303	.05825	0,00000	1,11743	.99000
30	337,50000	27,19737	1,20104	-.49749	.00151	.20163	-.11220	-.00302	.05487	0,00000	1,11100	.99000
31	348,75000	27,19737	1,27502	-.25362	.00150	.19235	-.09040	-.00300	.05196	0,00000	1,10512	.99000
32	360,00000	27,19737	1,30000	.00000	.00148	.17544	-.07780	-.00297	.04994	0,00000	1,10104	.99000

## BODY PINGS 15

1	11,25000	29,25000	1,27502	.25362	.00123	.15258	-.06051	-.00247	-.04413	0,00000	1,09332	.99501
2	22,50000	29,25000	1,20104	.49749	.00122	.12782	-.06047	-.00243	.04439	0,00000	1,09901	.99500
3	33,75000	29,25000	1,08091	.72224	.00120	.08704	-.04315	-.00239	.03427	0,00000	1,06933	.99516
4	45,00000	29,25000	.91924	.91924	.00118	.03136	-.03136	-.00235	.01775	0,00000	1,03592	.99524
5	56,25000	29,25000	.72224	1,08091	.00116	-.01523	-.04803	-.00232	.00664	0,00000	1,01343	.99532
6	67,50000	29,25000	.49749	1,20104	.00114	-.02782	-.09125	-.00228	.01080	0,00000	1,02145	.99539
7	78,75000	29,25000	.25362	1,27502	.00112	.00594	-.14173	-.00224	.02960	0,00000	1,05988	.99546
8	90,00000	29,25000	-.00000	1,30000	.00111	.08294	-.17544	-.00221	.05176	0,00000	1,16471	.99552
9	101,25000	29,25000	-.25362	1,27502	.00109	.17774	-.17499	-.00219	.06005	0,00000	1,12270	.99557
10	112,50000	29,25000	-.49749	1,20104	.00108	.23764	-.14967	-.00217	.05564	0,00000	1,11256	.99561
11	123,75000	29,25000	-.72224	1,08091	.00108	.22597	-.14168	-.00216	.05663	0,00000	1,11457	.99563
12	135,00000	29,25000	-.91924	.91924	.00108	.17546	-.17543	-.00215	.06070	0,00000	1,12200	.99564
13	146,25000	29,25000	-1,08091	.72224	.00108	.14169	-.22595	-.00216	.05664	0,00000	1,11457	.99563
14	157,50000	29,25000	-1,20104	.49749	.00108	.14968	-.23763	-.00217	.05564	0,00000	1,11256	.99561
15	168,75000	29,25000	-1,27502	.25362	.00109	.17499	-.17772	-.00219	.06005	0,00000	1,12270	.99557
16	180,00000	29,25000	-1,30000	-.00000	.00111	.17544	-.08292	-.00221	.05175	0,00000	1,10470	.99552
17	191,25000	29,25000	-1,27502	-.25362	.00112	.14172	-.00591	-.00224	.02959	0,00000	1,05986	.99546
18	202,50000	29,25000	-1,20104	-.49749	.00114	.09123	.02786	-.00228	.01078	0,00000	1,02181	.99539
19	213,75000	29,25000	-1,08091	-.72224	.00114	.04801	.01527	-.00232	.00662	0,00000	1,01339	.99532
20	225,00000	29,25000	-.91924	-.91924	.00118	.03132	-.03132	-.00235	.01773	0,00000	1,03587	.99524
21	236,25000	29,25000	-.72224	-1,08091	.00120	.04313	-.08703	-.00239	.03426	0,00000	1,06932	.99516
22	247,50000	29,25000	-.49749	-1,20104	.00122	.06049	-.12783	-.00243	.04400	0,00000	1,09902	.99500
23	258,75000	29,25000	-.25362	-1,27502	.00123	.08057	-.15259	-.00247	.04615	0,00000	1,09346	.99501
24	270,00000	29,25000	.00000	-1,30000	.00125	.05312	-.17544	-.00250	.04473	0,00000	1,09049	.99000
25	281,25000	29,25000	.25362	-1,27502	.00126	.06094	-.19821	-.00252	.04601	0,00000	1,09338	.99000
26	292,50000	29,25000	.49749	-1,20104	.00127	.09078	-.21050	-.00254	.05142	0,00000	1,10403	.99000
27	303,75000	29,25000	.72224	-1,08091	.00128	.13174	-.20331	-.00255	.05761	0,00000	1,11655	.99000

Figure 18.- Continued.

28	315.00000	29.25000	.91924	-.91924	.00128	.17546	-.17543	-.00256	.04028	0.00000	1.12195	.99443
29	328.25000	29.25000	1.00091	-.72224	.00128	.20433	-.13371	-.00255	.05741	0.00000	1.11654	.99444
30	337.50000	29.25000	1.20104	-.49749	.00127	.21052	-.09074	-.00254	.05142	0.00000	1.11401	.99486
31	348.75000	29.25000	1.27502	-.25362	.00126	.19823	-.06088	-.00252	.04599	0.00000	1.09385	.99490
32	380.00000	29.25000	1.30000	.00000	.00125	.17544	-.05306	-.00250	.04472	0.00000	1.09066	.99495

RDY RING= 1A

1	11.25000	31.30263	1.27502	.25362	.00104	.14433	-.01905	-.00210	.01433	0.00000	1.04945	.99573
2	22.50000	31.30263	1.20104	.49749	.00103	.12334	-.04966	-.00207	.04159	0.00000	1.04414	.99582
3	33.75000	31.30263	1.08091	.72224	.00102	.10456	-.08934	-.00203	.04401	0.00000	1.04964	.99588
4	45.00000	31.30263	.91924	.91924	.00100	.08935	-.08935	-.00200	.01759	0.00000	1.07604	.99596
5	56.25000	31.30263	.72224	1.08091	.00098	.02469	-.07471	-.00196	.02693	0.00000	1.05448	.99603
6	67.50000	31.30263	.49749	1.20104	.00097	.00014	-.10272	-.00193	.02360	0.00000	1.00771	.99609
7	78.75000	31.30263	.25362	1.27502	.00095	.01577	-.14368	-.00190	.03342	0.00000	1.00747	.99616
8	90.00000	31.30263	.00000	1.30000	.00094	.07341	-.17544	-.00187	.05016	0.00000	1.01147	.99621
9	101.25000	31.30263	-.25362	1.27502	.00093	.15157	-.18019	-.00185	.06045	0.00000	1.12210	.99626
10	112.50000	31.30263	-.49749	1.20104	.00092	.20775	-.16205	-.00183	.05964	0.00000	1.12065	.99629
11	123.75000	31.30263	-.72224	1.08091	.00091	.20918	-.15289	-.00182	.05922	0.00000	1.11980	.99631
12	135.00000	31.30263	-.91924	.91924	.00091	.17546	-.13543	-.00182	.06105	0.00000	1.12351	.99632
13	146.25000	31.30263	-1.08091	.72224	.00091	.15291	-.20916	-.00182	.05922	0.00000	1.11980	.99631
14	157.50000	31.30263	-1.20104	.49749	.00092	.16206	-.20772	-.00183	.05964	0.00000	1.12065	.99629
15	168.75000	31.30263	-1.27502	.25362	.00093	.16020	-.15154	-.00185	.06045	0.00000	1.12210	.99626
16	180.00000	31.30263	-1.30000	.00000	.00094	.17544	-.07338	-.00187	.05016	0.00000	1.10146	.99621
17	191.25000	31.30263	-1.27502	-.25362	.00095	.14368	-.01573	-.00190	.01341	0.00000	1.06758	.99616
18	202.50000	31.30263	-1.20104	-.49749	.00097	.10270	.00019	-.00193	.02357	0.00000	1.04749	.99609
19	213.75000	31.30263	-1.08091	-.72224	.00098	.07469	-.02469	-.00196	.02691	0.00000	1.05448	.99603
20	225.00000	31.30263	-.91924	-.91924	.00100	.08933	-.08933	-.00200	.03758	0.00000	1.07604	.99596
21	236.25000	31.30263	-.72224	-1.08091	.00102	.06937	-.10457	-.00203	.04402	0.00000	1.08964	.99588
22	247.50000	31.30263	-.49749	-1.20104	.00103	.04966	-.12337	-.00207	.04151	0.00000	1.09414	.99582
23	258.75000	31.30263	-.25362	-1.27502	.00105	.01912	-.14434	-.00210	.01436	0.00000	1.06950	.99573
24	270.00000	31.30263	.00000	-1.30000	.00106	.00634	-.17544	-.00213	.01092	0.00000	1.04254	.99570
25	281.25000	31.30263	.25362	-1.27502	.00107	.02472	-.20542	-.00215	.03591	0.00000	1.07249	.99566
26	292.50000	31.30263	.49749	-1.20104	.00108	.06876	-.21961	-.00216	.04658	0.00000	1.09424	.99562
27	303.75000	31.30263	.72224	-1.08091	.00109	.12422	-.20967	-.00217	.05663	0.00000	1.11457	.99560
28	315.00000	31.30263	.91924	-.91924	.00109	.17545	-.17540	-.00218	.04068	0.00000	1.12275	.99559
29	326.25000	31.30263	1.08091	-.72224	.00109	.20968	-.12420	-.00217	.05663	0.00000	1.11457	.99560
30	337.50000	31.30263	1.20104	-.49749	.00108	.21963	-.06874	-.00216	.04658	0.00000	1.09424	.99562
31	348.75000	31.30263	1.27502	-.25362	.00107	.20543	-.02468	-.00215	.03592	0.00000	1.07249	.99566
32	380.00000	31.30263	1.30000	.00000	.00106	.17544	-.00628	-.00213	.03090	0.00000	1.04254	.99570

RDY RING= 17

1	11.25000	33.35526	1.27502	.25362	.00090	.13291	.03838	-.00180	.01205	0.00000	1.02437	.99635
2	22.50000	33.35526	1.20104	.49749	.00089	.10142	.00325	-.00178	.02243	0.00000	1.04517	.99641
3	33.75000	33.35526	1.08091	.72224	.00087	.08909	-.04755	-.00175	.03664	0.00000	1.07413	.99646
4	45.00000	33.35526	.91924	.91924	.00084	.08450	-.08454	-.00172	.04410	0.00000	1.08021	.99652
5	56.25000	33.35526	.72224	1.08091	.00080	.06463	-.10140	-.00169	.04283	0.00000	1.08464	.99658
6	67.50000	33.35526	.49749	1.20104	.00083	.04090	-.11972	-.00166	.03923	0.00000	1.07936	.99664
7	78.75000	33.35526	.25362	1.27502	.00082	.04181	-.14884	-.00163	.04194	0.00000	1.06849	.99670
8	90.00000	33.35526	.00000	1.30000	.00081	.07905	-.17540	-.00161	.05169	0.00000	1.04457	.99674
9	101.25000	33.35526	-.25362	1.27502	.00080	.13999	-.18249	-.00159	.05999	0.00000	1.12135	.99678
10	112.50000	33.35526	-.49749	1.20104	.00079	.18805	-.16984	-.00158	.06105	0.00000	1.12350	.99681
11	123.75000	33.35526	-.72224	1.08091	.00078	.19712	-.16094	-.00157	.06055	0.00000	1.12250	.99683
12	135.00000	33.35526	-.91924	.91924	.00078	.17546	-.17541	-.00157	.06132	0.00000	1.12406	.99685
13	146.25000	33.35526	-1.08091	.72224	.00078	.16098	-.19708	-.00157	.06056	0.00000	1.12251	.99683
14	157.50000	33.35526	-1.20104	.49749	.00079	.16985	-.18892	-.00158	.06105	0.00000	1.12350	.99681

Figure 18.- Continued.



15	164.75000	33.35526	-1.27562	.25362	.00000	.18250	-.13495	-.00159	.05998	.0.00000	1.12135	.99678
16	180.00000	33.35526	-1.30000	-.00000	.00001	.17544	-.07941	-.00161	.05168	.0.00000	1.10456	.99674
17	191.25000	33.35526	-1.27502	-.25362	.00002	.14885	-.04176	-.00163	.04193	.0.00000	1.08481	.99670
18	202.50000	33.35526	-1.20104	-.49749	.00003	.11970	-.00086	-.00166	.03922	.0.00000	1.07934	.99664
19	213.75000	33.35526	-1.08091	-.72224	.00004	.10139	-.06462	-.00169	.04282	.0.00000	1.08663	.99658
20	225.00000	33.35526	-.91924	-.91924	.00006	.08457	-.08457	-.00172	.04411	.0.00000	1.08923	.99652
21	236.25000	33.35526	-.72224	-1.08091	.00007	.06761	-.09003	-.00175	.03667	.0.00000	1.07417	.99646
22	247.50000	33.35526	-.49749	-1.20104	.00009	-.00319	-.10145	-.00178	.02245	.0.00000	1.04542	.99641
23	258.75000	33.35526	-.25362	-1.27502	.00009	-.03833	-.15292	-.00180	.01207	.0.00000	1.02441	.99635
24	270.00000	33.35526	-.00000	-1.30000	.00001	-.04914	-.17544	-.00183	.01338	.0.00000	1.02707	.99631
25	281.25000	33.35526	-.25362	-1.27502	.00002	-.00551	-.21144	-.00185	.02545	.0.00000	1.05148	.99627
26	292.50000	33.35526	-.49749	-1.20104	.00003	.05159	-.22674	-.00186	.04200	.0.00000	1.08498	.99624
27	303.75000	33.35526	-.72224	-1.08091	.00003	.11760	-.21450	-.00187	.05573	.0.00000	1.11274	.99622
28	315.00000	33.35526	-.91924	-.91924	.00004	.17505	-.17544	-.00187	.06100	.0.00000	1.12340	.99621
29	326.25000	33.35526	-.08091	-.72224	.00003	.21450	-.11699	-.00187	.05573	.0.00000	1.11274	.99622
30	337.50000	33.35526	-.20104	-.49749	.00003	.22674	-.05158	-.00186	.04200	.0.00000	1.08497	.99624
31	348.75000	33.35526	-.27502	-.25362	.00002	.21144	.00553	-.00185	.02544	.0.00000	1.05146	.99627
32	360.00000	33.35526	-.30000	-.00000	.00001	.17544	.03917	-.00183	.01337	.0.00000	1.02704	.99631

TOTAL NUMBER OF PRESSURE POINTS, JCPTS = 264

CONTROL POINT COORDINATES FOR 3 CHORDWISE BY 5 SPANWISE PANELS ON WING 1 OR R, 5 SPANWISE ON WING 2 OR L  
AND 5 SPANWISE PANELS ON WING 3 OR U, 5 SPANWISE ON WING 4 OR D

J	X(J)	Y(J)	Z(J)	RU(J)	RV(J)	RW(J)	VVRTX	WVRTX
1	1.23112	1.53096	0.00000	.73009E-03	.12641E+00	.12640E+00	0.	0.
2	2.38667	1.53096	0.00000	.67838E-03	.12642E+00	.12691E+00	0.	0.
3	3.54222	1.53096	0.00000	.63160E-03	.12643E+00	.12689E+00	0.	0.
4	1.41565	1.99870	0.00000	.72683E-03	.74025E-01	.74581E-01	0.	0.
5	2.48119	1.99870	0.00000	.67887E-03	.74034E-01	.74559E-01	0.	0.
6	3.54672	1.99870	0.00000	.63539E-03	.74051E-01	.74538E-01	0.	0.
7	1.40017	2.46640	0.00000	.72543E-03	.48483E-01	.49061E-01	0.	0.
8	2.57570	2.46640	0.00000	.68143E-03	.48500E-01	.49043E-01	0.	0.
9	3.55122	2.46640	0.00000	.64127E-03	.48516E-01	.49027E-01	0.	0.
10	1.78466	2.93403	0.00000	.72621E-03	.34141E-01	.34740E-01	0.	0.
11	2.67019	2.93403	0.00000	.68508E-03	.34160E-01	.34725E-01	0.	0.
12	3.55572	2.93403	0.00000	.64898E-03	.34177E-01	.34711E-01	0.	0.
13	1.96912	3.40158	0.00000	.72815E-03	.25290E-01	.25908E-01	0.	0.
14	2.76467	3.40158	0.00000	.69144E-03	.25309E-01	.25895E-01	0.	0.
15	3.56022	3.40158	0.00000	.65783E-03	.25326E-01	.25883E-01	0.	0.
16	1.23112	-1.53096	0.00000	.68840E-03	.12645E+00	.12694E+00	0.	0.
17	2.38667	-1.53096	0.00000	.64045E-03	.12645E+00	.12691E+00	0.	0.
18	3.54222	-1.53096	0.00000	.59508E-03	.12645E+00	.12689E+00	0.	0.
19	1.41565	-1.99870	0.00000	.63974E-03	.74120E-01	.74581E-01	0.	0.
20	2.48119	-1.99870	0.00000	.59900E-03	.74125E-01	.74559E-01	0.	0.
21	3.54672	-1.99870	0.00000	.56302E-03	.74129E-01	.74538E-01	0.	0.
22	1.40017	-2.46640	0.00000	.63001E-03	.48627E-01	.49061E-01	0.	0.
23	2.57570	-2.46640	0.00000	.59399E-03	.48631E-01	.49043E-01	0.	0.
24	3.55122	-2.46640	0.00000	.56193E-03	.48636E-01	.49027E-01	0.	0.
25	1.78466	-2.93403	0.00000	.62103E-03	.34329E-01	.34740E-01	0.	0.
26	2.67019	-2.93403	0.00000	.58800E-03	.34333E-01	.34725E-01	0.	0.
27	3.55572	-2.93403	0.00000	.55908E-03	.34336E-01	.34711E-01	0.	0.
28	1.96912	-3.40158	0.00000	.61243E-03	.25519E-01	.25908E-01	0.	0.
29	2.76467	-3.40158	0.00000	.58375E-03	.25521E-01	.25895E-01	0.	0.
30	3.56022	-3.40158	0.00000	.55720E-03	.25523E-01	.25883E-01	0.	0.

Figure 18.- Continued.

31	1.25112	0.00000	1.55096	.60800F=03	-.12690E+00	-.12645E+00	0.	0.
32	2.18667	0.00000	1.53046	.60465F=03	-.12641E+00	-.12645E+00	0.	0.
33	3.54222	0.00000	1.53046	.58506E=03	-.12640E+00	-.12645E+00	0.	0.
34	1.41585	0.00000	1.49870	.63070F=03	-.74541E=01	-.74120E=01	0.	0.
35	2.48119	0.00000	1.49870	.59906E=03	-.74554E=01	-.74125E=01	0.	0.
36	3.54672	0.00000	1.49870	.56302E=03	-.74538E=01	-.74120E=01	0.	0.
37	1.66017	0.00000	2.46646	.63001F=03	-.49001E=01	-.48627E=01	0.	0.
38	2.57570	0.00000	2.46646	.59300F=03	-.49003E=01	-.48631E=01	0.	0.
39	3.55122	0.00000	2.46646	.61033F=03	-.49027E=01	-.48636E=01	0.	0.
40	1.78486	0.00000	2.93403	.62103F=03	-.34740E=01	-.34329E=01	0.	0.
41	2.67019	0.00000	2.93403	.68490F=03	-.34725E=01	-.34333E=01	0.	0.
42	3.55572	0.00000	2.93403	.65908F=03	-.34711E=01	-.34334E=01	0.	0.
43	1.98912	0.00000	3.46158	.61243F=03	-.25490E=01	-.25519E=01	0.	0.
44	2.78487	0.00000	3.46158	.58375F=03	-.25495E=01	-.25521E=01	0.	0.
45	3.56022	0.00000	3.46158	.55720F=03	-.25483E=01	-.25523E=01	0.	0.
46	1.25112	0.00000	-1.53046	.73000F=03	-.12644E+00	-.12641E+00	0.	0.
47	2.18667	0.00000	-1.53046	.67838E=03	-.12641E+00	-.12642E+00	0.	0.
48	3.54222	0.00000	-1.53046	.63100E=03	-.12640E+00	-.12643E+00	0.	0.
49	1.41585	0.00000	-1.49870	.72644F=03	-.74541E=01	-.74025E=01	0.	0.
50	2.48119	0.00000	-1.49870	.67847F=03	-.74549E=01	-.74039E=01	0.	0.
51	3.54672	0.00000	-1.49870	.63540F=03	-.74538E=01	-.74051E=01	0.	0.
52	1.66017	0.00000	-2.46646	.72504F=03	-.49001E=01	-.48603E=01	0.	0.
53	2.57570	0.00000	-2.46646	.68103F=03	-.49003E=01	-.48506E=01	0.	0.
54	3.55122	0.00000	-2.46646	.64127F=03	-.49027E=01	-.48516E=01	0.	0.
55	1.78486	0.00000	-2.93403	.72621F=03	-.34740E=01	-.34141E=01	0.	0.
56	2.67019	0.00000	-2.93403	.68490F=03	-.34725E=01	-.34160E=01	0.	0.
57	3.55572	0.00000	-2.93403	.64898F=03	-.34711E=01	-.34177E=01	0.	0.
58	1.98912	0.00000	-3.46158	.72815F=03	-.25490E=01	-.25290E=01	0.	0.
59	2.78487	0.00000	-3.46158	.69164F=03	-.25495E=01	-.25309E=01	0.	0.
60	3.56022	0.00000	-3.46158	.65783F=03	-.25483E=01	-.25326E=01	0.	0.

CONTROL POINT COORDINATES FOR HJP-9 (WING FRAME)

	X(J)	Y(J)	Z(J)	THX(J)	THY(J)	THZ(J)
61	1.14000	1.25052	-.24874	-.13491E=02	-.14221E=01	.34655E=02
62	1.14000	1.25014	-.70836	-.15717E=01	-.88792E=02	.20553E=01
63	1.14000	-.70836	1.06014	-.15717E=01	.20553E=01	-.88792E=02
64	1.14000	-.24874	1.25052	-.13491E=02	.34655E=02	-.14221E=01
65	1.14000	-.24874	1.25052	-.13491E=02	.34655E=02	-.14221E=01
66	1.14000	-.70836	1.06014	-.15717E=01	.20553E=01	-.88792E=02
67	1.14000	-1.06014	-.70836	-.15717E=01	-.88792E=02	.20553E=01
68	1.14000	-1.25052	-.24874	-.13491E=02	.14221E=01	.34655E=02
69	1.14000	-1.25052	-.24874	-.13491E=02	.14221E=01	.34655E=02
70	1.14000	-1.06014	-.70836	-.15717E=01	-.88792E=02	.20553E=01
71	1.14000	-.70836	1.06014	-.15717E=01	.20553E=01	-.88792E=02
72	1.14000	-.24874	1.25052	-.13491E=02	.34655E=02	-.14221E=01
73	1.14000	-.24874	1.25052	-.13491E=02	.34655E=02	-.14221E=01
74	1.14000	-.70836	1.06014	-.15717E=01	.20553E=01	-.88792E=02
75	1.14000	1.06014	-.70836	-.15717E=01	-.88792E=02	.20553E=01
76	1.14000	1.25052	-.24874	-.13491E=02	-.14221E=01	.34655E=02
77	2.34000	1.25052	-.24874	-.10003E=01	-.51303E=02	-.54293E=02
78	2.34000	1.06014	-.70836	-.71993E=02	-.60701E=03	-.75112E=02
79	2.34000	-.70836	1.06014	-.71993E=02	-.75112E=02	-.60701E=03
80	2.34000	-.24874	1.25052	-.10003E=01	-.54293E=02	-.51303E=02
81	2.34000	-.24874	1.25052	-.10003E=01	.54293E=02	.51303E=02
82	2.34000	-.70836	1.06014	-.71993E=02	.75112E=02	.60701E=03

Figure 18.- Continued.

83	2.34000	-1.06014	.70836	-.71993E-02	-.60701E-03	-.75132E-02
84	2.34000	-1.25052	.24874	-.10403E-01	.31303E-02	-.54293E-02
85	2.34000	-1.25052	-.24874	-.10403E-01	.31303E-02	.54293E-02
86	2.34000	-1.06014	-.70836	-.71993E-02	-.60701E-03	.75132E-02
87	2.34000	-.70836	-1.06014	-.71993E-02	.75132E-02	-.60701E-03
88	2.34000	-.24874	-1.25052	-.10403E-01	.54293E-02	.31303E-02
89	2.34000	.24874	-1.25052	-.10403E-01	-.54293E-02	.31303E-02
90	2.34000	.70836	-1.06014	-.71993E-02	-.75132E-02	-.60701E-03
91	2.34000	1.06014	-.70836	-.71993E-02	.60701E-03	.75132E-02
92	2.34000	1.25052	-.24874	-.10403E-01	.31303E-02	.54293E-02
93	3.54000	1.25052	.24874	.26703E-01	.18903E-01	-.45436E-01
94	3.54000	1.06014	.70836	-.26070E-01	.94557E-02	.92392E-02
95	3.54000	.70836	1.06014	-.26070E-01	.92392E-02	.94557E-02
96	3.54000	.24874	1.25052	.26703E-01	-.45436E-01	.18903E-01
97	3.54000	-.24874	1.25052	.26703E-01	.45436E-01	.18903E-01
98	3.54000	-.70836	1.06014	-.26070E-01	.92392E-02	.94557E-02
99	3.54000	-1.06014	.70836	-.26070E-01	.94557E-02	.92392E-02
100	3.54000	-1.25052	.24874	.26703E-01	-.18903E-01	-.45436E-01
101	3.54000	-1.25052	-.24874	.26703E-01	-.18903E-01	.45436E-01
102	3.54000	-1.06014	-.70836	-.26070E-01	.94557E-02	.92392E-02
103	3.54000	-.70836	-1.06014	-.26070E-01	.92392E-02	.94557E-02
104	3.54000	-.24874	-1.25052	.26703E-01	.45436E-01	.18903E-01
105	3.54000	.24874	-1.25052	.26703E-01	-.45436E-01	.18903E-01
106	3.54000	.70836	-1.06014	-.26070E-01	.92392E-02	.94557E-02
107	3.54000	1.06014	-.70836	-.26070E-01	.94557E-02	.92392E-02
108	3.54000	1.25052	-.24874	.26703E-01	.18903E-01	.45436E-01

## LOADING INFORMATION

MACH NUMBER = .17000E+01  
 ANGLE OF ATTACK = 10.000 DEGRFES  
 SIDE SLIP ANGLE = 10.000 DEGRFES  
 WING AREA = 13.44666  
 REFERENCE AREA = 9.30920  
 REFERENCE LENGTH = 2.64000  
 EXPOSED WING SPAN = 4.54000  
 MOMENT CENTER: XM = 10.50000  
 ZM = 0.00000

## UJWINE TYPE LOADING PRESSURE

DEFL. ANGLE DEG.	TOTAL	FIN 1 OR R	FIN 2 OR L	FIN 3 OR U	FIN 4 OR D	INTERF. S.WELL
CTHR =	.30415E-01	0.00000	0.00000	0.00000	0.00000	
CZ =	.10224E+01	.10495E-01	.44137E-02	.48118E-02	.10495E-01	
CY =	-.10223E+01	.58122E+00	.28949E+00	0.	0.	.15172E+00
CM =	-.49633E+01	0.	0.	-.28940E+00	0.	-.15171E+00
CLN =	.49624E+01	-.39520E+01	-.19585E+01	0.	0.	.10521E+01
CLL =	.91616E-04	0.	0.	.19578E+01	.39521E+01	.10527E+01
		-.50670E+00	.27706E+00	-.27699E+00	.50671E+00	.47699E+14

Figure 18:- Continued.

FOLLOWING ARE IN WIND-AXIS SYSTEM

CL =	.18091E+01	.00098E+00	.19062E+00	.19951E+00	.40090E+00	.20799E+00
CY-IND =	.A60H4E-04	.41099E+00	.20470E+00	-.20464E+00	-.41099E+00	.99703E-05
CDT =	.12540E+00	.90754E-01	.45604E-01	.45591E-01	.90754E-01	.52691E-01
CDI/CL**2 =	.10308E+00					
CM-IND =	-.0H471E+01	-.27945E+01	-.13844E+01	-.13844E+01	-.27945E+01	-.14899E+01
CLN-IND =	-.45A62E-03	-.25845E+01	-.14105E+01	.14100E+01	.25845E+01	-.66543E-04

NOTE: L.E. OF LEAD PANEL IN FIRST CHORDWISE ROW IS SUPERSONIC

-----RIGHT WING-----

SPANWISE DISTRIBUTIONS

1	Y/(B/2)	CN*C/(2*B)	CT*C/(2*B)	CV1*C/(2*B)	CVTOT*C/(2*B)	CS*C/(2*B)	CSINT	YBAR	GAMNET(1)	GAMMA,LE/VINF	XLE
1	.65426	.16708	0.00000	0.00000	.00025	0.00000	0.00000	0.00000	-.78235	0.00000	.13334
2	.85415	.16341	0.00000	0.00000	.00112	0.00000	0.00000	0.00000	.01711	0.00000	.40340
3	1.05402	.15153	0.00000	0.00000	.00153	0.00000	0.00000	0.00000	.05558	0.00000	.67342
4	1.25386	.12992	0.00000	0.00000	.00187	0.00000	0.00000	0.00000	.10112	0.00000	.94341
5	1.45367	.09252	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.17509	0.00000	1.21339
6	1.55556	0.00000							.43345		

SUMFX = 0.  
 SUMFY1 = 0.  
 SUMFY2 = .37762E-02  
 SUMFT2 = .23655E-01

SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SECTION FORCE PER UNIT LENGTH /(Q*TIPCHORD)	GAMMA,SE /VINF	YBAR	XSE
1	1	.33333	.00354	.00063	3.64000	1.35100
2	2	.66667	.03255	.00600	3.64000	2.10067
3	3	1.00000	.03840	.01321	3.64000	2.85033

Figure 18.- Continued.

\*\*\*\*T.F. FIN VORTEX INFO\*\*\*\*

IVRT GAMMA/VINF Y.C.G.

1 .78196 3.27310

----- LEFT HING-----

# SPANWISE DISTRIBUTIONS

I	Y/(H/2)	CN=C/(2*H)	CT=C/(2*H)	CV1=C/(2*H)	CVINT=C/(2*H)	CS=C/(2*H)	CSTNT	YBAR	GAMNET(I)	GAMMA,LE/VINF	XLE
7	-.65426	.04806	0.00000	0.00000	-.00151	0.00000	0.00000	0.00000	.22503	0.00000	.13334
8	-.85415	.06115	0.00000	0.00000	-.00066	0.00000	0.00000	0.00000	.04143	0.00000	.40340
9	-1.05402	.07844	0.00000	0.00000	-.00010	0.00000	0.00000	0.00000	.08102	0.00000	.67342
10	-1.25386	.08807	0.00000	0.00000	-.00038	0.00000	0.00000	0.00000	.04513	0.00000	.94341
11	-1.45367	.07516	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.06041	0.00000	1.21335
12	-1.55556	0.00000							-.35211		

SUMFX = 0.  
 SUMFY1 = 0.  
 SUMFY2 = -.21914E-02  
 SUMFT2 = -.23866E-01

# SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(Q*TIPCHORD)	GAMMA,SE /VINF	YBAR	XSE
1	1	.33333	-.00686	-.00122	-3.64000	1.35100
2	2	.66667	-.03686	-.00776	-3.64000	2.10067
3	3	1.00000	-.03080	-.01322	-3.64000	2.85053

\*\*\*\*T.F. FIN VORTEX INFO\*\*\*\*

IVRT GAMMA/VINF Y.C.G.

2 .18725 -2.19543  
 3 -.41216 -3.57139

Figure 18.- Continued.

-----UPPER ATC-----

# SPANWISE DISTRIBUTIONS

I	Z/(H/2)	C1+C/(2*H)	C1+C/(2*H)	C21+C/(2*H)	C21+C/(2*H)	C3+C/(2*H)	CSJAT	ZHAW	GAMMA,ET(T)	GAMMA,LE/VINF	XLE
13	.65026	.04004	0.00000	0.00000	.00151	0.00000	0.00000	0.00000	-.22494	0.00000	.13334
14	.85415	.06113	0.00000	0.00000	.00000	0.00000	0.00000	0.00000	-.06131	0.00000	.06340
15	1.05002	.07002	0.00000	0.00000	.00010	0.00000	0.00000	0.00000	-.08170	0.00000	.07342
16	1.25386	.05004	0.00000	0.00000	.00038	0.00000	0.00000	0.00000	-.04515	0.00000	.04341
17	1.45367	.07514	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.06035	0.00000	1.21335
18	1.55556	0.00000							.35205		

SUMFX = 0.  
 SUMFZ1 = 0.  
 SUMFZ2 = .21409E-02  
 SUMFT2 = .23602E-01

## SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIP(=0.0)	SUCTION FORCE PER UNIT LENGTH /(C*TIP(=0.0))	GAMMA,SE /VINF	ZHAW	XSE
1	4	.33333	.00607	.00122	3.64000	1.35100
2	5	.66667	.03606	.00776	3.64000	2.10767
3	6	1.00000	.03079	.01322	3.64000	2.85033

\*\*\*\*F, FIN VORTEX INFO\*\*\*\*

(NOT GAMMA/VINF Z.C.G.)

4 -.18721 2.19551  
 5 .01204 3.57143

Figure 18.- Continued.

## SPANWISE DISTRIBUTIONS

I	Z/(B/2)	CN+C/(2*B)	CT+C/(2*B)	CZ1+C/(2*B)	CZTOT+C/(2*B)	CS+C/(2*B)	CSINT	ZBAR	GAMMA(1)	GAMMA,LE/VINF
19	-.65426	.16709	0.00000	0.00000	-.00025	0.00000	0.00000	0.00000	.78236	0.00000
20	-.85415	.16342	0.00000	0.00000	-.00112	0.00000	0.00000	0.00000	-.01711	0.00000
21	-1.05402	.15153	0.00000	0.00000	-.00153	0.00000	0.00000	0.00000	-.05557	0.00000
22	-1.25386	.12992	0.00000	0.00000	-.00167	0.00000	0.00000	0.00000	-.10112	0.00000
23	-1.45367	.09252	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.17509	0.00000
24	-1.55556	0.00000							-.43346	

SUMFX = 0.  
 SUMFZ1 = 0.  
 SUMFZ2 = -.37762E-02  
 SUMFT2 = -.23655E-01

## SIDE FORCE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(10*TIPCHORD)	GAMMA,SE /VINF	ZBAR	XSE
1	7	.34333	-.00354	-.00063	-3.64000	1.35100
2	8	.66667	-.03255	-.00640	-3.64000	2.10067
3	9	1.00000	-.03840	-.01321	-3.64000	2.85033

\*\*\*\*T.E. FIN VORTEX INFO\*\*\*\*

IVRT GAMMA/VINF Z,C.G.

6 -.78196 -3.27321

## VELOCITIES AND BERNOULLI PRESSURES AT CONTROL POINTS IMMEDIATELY ABOVE AND BELOW HORIZONTAL WING SURFACE

J	X(J)	Y(J)	Z(J)	UTOT4	VTOT4	WTOT4	PRESS4	UTOT8	VTOT8	WTOT8	PRESS8
1	1.231118	1.530959	0.000000	.129145	.068203	-.173650	-.185699	-.129328	.217259	-.173650	.358780
2	2.386670	1.530959	0.000000	.101384	.088661	-.173650	-.137395	-.107142	.169123	-.173650	.307666
3	3.542222	1.530959	0.000000	.150268	.168505	-.314650	-.223650	-.060070	.268985	-.032650	.169474
4	1.415654	1.998701	0.000000	.152781	-.031297	-.173650	-.241259	-.138542	.136910	-.173650	.383371
5	2.481188	1.998701	0.000000	.113561	.058478	-.173650	-.162344	-.109953	.144508	-.173650	.313307

Figure 18.- Continued.

6	3.546723	1.999701	0.000000	1.161209	1.126025	1.314650	1.240721	1.042107	1.15153	1.032650	1.131724
7	1.600170	2.466397	0.000000	1.191832	1.054983	1.173650	1.297720	1.110493	1.19796	1.173650	1.312729
8	2.575697	2.466397	0.000000	1.299001	1.030109	1.173650	1.193634	1.116276	1.24824	1.173650	1.326221
9	3.551224	2.466397	0.000000	1.206549	1.076211	1.314650	1.303594	1.027879	1.10594	1.032650	1.016133
10	1.784662	2.934030	0.000000	1.144754	1.093172	1.173650	1.227381	1.155865	1.19004	1.173650	1.429061
11	2.670193	2.934030	0.000000	1.167200	1.122209	1.173650	1.251417	1.080142	1.167411	1.173650	1.237021
12	3.555723	2.934030	0.000000	1.209438	1.100777	1.314650	1.304929	1.074149	1.26403	1.032650	1.102489
13	1.969121	1.401580	0.000000	1.157981	1.032492	1.173650	1.214765	1.122717	1.04553	1.173650	1.345299
14	2.746672	1.401580	0.000000	1.104232	1.026553	1.173650	1.153399	1.061653	1.00537	1.173650	1.190837
15	3.560222	1.401580	0.000000	1.101044	1.046797	1.314650	1.160045	1.003357	1.065704	1.032650	1.026616
16	1.231118	1.530959	0.000000	1.037972	1.141557	1.173650	1.014657	1.035365	1.139216	1.173650	1.138411
17	2.386670	1.530959	0.000000	1.034291	1.141043	1.173650	1.007384	1.045334	1.150396	1.173650	1.161572
18	1.542222	1.530959	0.000000	1.129857	1.146280	1.314650	1.185776	1.083083	1.138240	1.032650	1.117261
19	1.415654	1.998701	0.000000	1.063527	1.222175	1.173650	1.065850	1.046209	1.156796	1.173650	1.164037
20	2.431188	1.998701	0.000000	1.060120	1.148307	1.173650	1.057346	1.039398	1.10002	1.173650	1.146557
21	3.546723	1.998701	0.000000	1.137455	1.143383	1.314650	1.205806	1.078405	1.11942	1.032650	1.109509
22	1.600170	2.466397	0.000000	1.127203	1.218945	1.173650	1.176074	1.046054	1.118724	1.173650	1.161675
23	2.575697	2.466397	0.000000	1.075503	1.162503	1.173650	1.085958	1.10743	1.173650	1.173650	1.18398
24	3.551224	2.466397	0.000000	1.154574	1.136504	1.314650	1.230745	1.086113	1.23330	1.032650	1.123540
25	1.784662	2.934030	0.000000	1.119540	1.145904	1.173650	1.162743	1.128882	1.003715	1.173650	1.146459
26	2.670193	2.934030	0.000000	1.126500	1.156456	1.173650	1.173723	1.036527	1.03692	1.173650	1.136796
27	3.555723	2.934030	0.000000	1.177442	1.165272	1.314650	1.264400	1.121313	1.094432	1.032650	1.194191
28	1.969121	1.401580	0.000000	1.155547	1.096944	1.173650	1.222228	1.120515	1.062396	1.173650	1.262251
29	2.746672	1.401580	0.000000	1.079984	1.106955	1.173650	1.077793	1.037631	1.061685	1.173650	1.129956
30	3.560222	1.401580	0.000000	1.078544	1.104215	1.314650	1.111764	1.029624	1.009401	1.032650	1.022946

VELOCITIES AND HERNIMILLI PRESSURES AT CONTROL POINTS IMMEDIATELY TO RIGHT AND LEFT OF VERTICAL WING SURFACE

J	X(J)	Y(J)	Z(J)	UTOTR	VTOTR	WTOTR	PRESSR	UTOTL	VTOTL	WTOTL	PRESSL
31	1.231118	0.000000	1.530959	1.035304	1.173650	1.139216	1.138369	0.037954	1.173450	1.181535	1.010620
32	2.386670	0.000000	1.530959	1.045320	1.173650	1.150384	1.161541	0.034277	1.173650	1.181021	1.007536
33	1.542222	0.000000	1.530959	1.084091	1.314650	1.138222	1.117274	1.24856	0.02650	1.146260	1.185776
34	1.415654	0.000000	1.998701	1.046223	1.173650	1.158802	1.163478	0.063501	1.173450	1.222151	1.065749
35	2.481188	0.000000	1.998701	1.039379	1.173650	1.129985	1.146515	0.062103	1.173450	1.168275	1.057514
36	3.546723	0.000000	1.998701	1.178414	1.314650	1.131406	1.109527	1.137850	0.03200	1.143304	1.205941
37	1.600170	0.000000	2.466397	1.046425	1.173650	1.118760	1.161013	1.27173	1.173650	1.218947	1.178027
38	2.575697	0.000000	2.466397	1.046425	1.173650	1.110761	1.188352	0.75492	1.173650	1.162565	1.085919
39	3.551224	0.000000	2.466397	1.086130	1.314650	1.123325	1.123571	1.154557	0.02450	1.134402	1.236721
40	1.784662	0.000000	2.934030	1.126459	1.173650	1.003770	1.144332	1.119534	1.173450	1.146027	1.162704
41	2.670193	0.000000	2.934030	1.036504	1.173650	0.93750	1.134756	1.26517	1.173450	1.156404	1.173450
42	3.555723	0.000000	2.934030	1.211337	1.314650	0.904493	1.184220	1.177617	0.032650	1.105325	1.264566
43	1.969121	0.000000	1.401580	1.126505	1.174650	0.862352	1.262256	1.155537	1.173450	1.047021	1.222210
44	2.746672	0.000000	1.401580	1.037616	1.173650	0.861740	1.29938	0.79969	1.173650	1.040904	1.097761
45	1.542222	0.000000	1.401580	1.029639	1.314650	0.999867	1.022964	0.78530	0.02650	1.100277	1.111733
46	1.231118	0.000000	1.530959	1.129027	1.173650	1.217260	1.158778	1.29104	1.173650	1.082208	1.185907
47	2.386670	0.000000	1.530959	1.107104	1.173650	1.169127	1.107672	1.101386	1.173450	1.088804	1.137349
48	3.542222	0.000000	1.530959	1.066075	1.314650	1.208990	1.169483	1.150266	0.02450	1.166510	1.223645
49	1.415654	0.000000	1.998701	1.134563	1.173650	1.166918	1.136375	1.152782	1.173650	1.131200	1.201240
50	2.481188	0.000000	1.998701	1.109568	1.173650	1.104516	1.133356	1.115563	1.173650	1.054083	1.142346
51	1.542222	0.000000	1.998701	1.042110	1.314650	1.165161	1.131032	1.161207	0.02650	1.126033	1.207718
52	1.600170	0.000000	2.466397	1.110497	1.173650	1.119804	1.127334	1.191836	1.173650	1.054979	1.297723
53	2.575697	0.000000	2.466397	1.116279	1.173650	1.124831	1.129830	1.129830	1.173650	1.030114	1.193037
54	3.551224	0.000000	2.466397	1.277727	1.314650	1.10599	1.016130	1.206540	0.02650	1.076215	1.303595
55	1.784662	0.000000	2.934030	1.155870	1.173650	1.179950	1.029074	1.148759	1.173650	1.043172	1.227344
56	2.670193	0.000000	2.934030	1.086145	1.173650	1.107415	1.167202	1.172202	1.173450	1.122111	1.251420
57	3.555723	0.000000	2.934030	1.074198	1.314650	1.126807	1.102485	1.209430	0.02650	1.100780	1.304930

Figure 18.- Continued.



54	1.969121	0.000000	-3.401580	-.122722	.173650	-.194557	.345311	.157986	.173650	-.032490	-.234773
59	2.764672	0.000000	-3.401580	-.061665	.173650	-.090509	.190441	.104234	.173650	-.026654	-.153402
60	3.560222	0.000000	-3.401580	-.003356	.314650	-.065706	.022617	.101604	.032450	-.044798	-.160046

## PRESSURE LOADINGS AT CONTROL POINTS

J	X(J)	Y(J)	Z(J)	DELT.P.LIN.	DELT.P.HEMN.
1	1.231118	1.530959	0.000000	.516305	.544479
2	2.386670	1.530959	0.000000	.417051	.445061
3	3.542222	1.530959	0.000000	.420677	.393123
4	1.415654	1.998701	0.000000	.562686	.624629
5	2.481188	1.998701	0.000000	.447027	.475691
6	3.546723	1.998701	0.000000	.406632	.371745
7	1.600170	2.466397	0.000000	.605451	.610449
8	2.575697	2.466397	0.000000	.492153	.520055
9	3.551224	2.466397	0.000000	.357319	.285461
10	1.784662	2.934030	0.000000	.609237	.456443
11	2.670193	2.934030	0.000000	.494643	.488434
12	3.555723	2.934030	0.000000	.270477	.202441
13	1.969121	3.401580	0.000000	.561396	.540064
14	2.764672	3.401580	0.000000	.331792	.344234
15	3.560222	3.401580	0.000000	.194493	.182661
16	1.231118	-1.530959	0.000000	.144674	.153084
17	2.386670	-1.530959	0.000000	.159248	.164935
18	3.542222	-1.530959	0.000000	.064504	.068515
19	1.415654	-1.998701	0.000000	.219453	.229447
20	2.481188	-1.998701	0.000000	.199036	.203993
21	3.546723	-1.998701	0.000000	.118900	.096344
22	1.600170	-2.466397	0.000000	.347314	.337149
23	2.575697	-2.466397	0.000000	.268955	.274354
24	3.551224	-2.466397	0.000000	.136922	.107234
25	1.784662	-2.934030	0.000000	.492684	.477202
26	2.670193	-2.934030	0.000000	.326134	.308510
27	3.555723	-2.934030	0.000000	.112657	.080410
28	1.969121	-3.401580	0.000000	.552124	.484479
29	2.764672	-3.401580	0.000000	.235230	.227709
30	3.560222	-3.401580	0.000000	.097441	.088414
31	1.231118	0.000000	1.530959	.146599	.152449
32	2.386670	0.000000	1.530959	.159195	.168877
33	3.542222	0.000000	1.530959	.084531	.084500
34	1.415654	0.000000	1.998701	.210449	.229774
35	2.481188	0.000000	1.998701	.198264	.203424
36	3.546723	0.000000	1.998701	.118471	.096314
37	1.600170	0.000000	2.466397	.347196	.337040
38	2.575697	0.000000	2.466397	.268969	.274270
39	3.551224	0.000000	2.466397	.138453	.107149
40	1.784662	0.000000	2.934030	.492793	.477134
41	2.670193	0.000000	2.934030	.326044	.308442
42	3.555723	0.000000	2.934030	.112565	.080444
43	1.969121	0.000000	3.401580	.552084	.484464
44	2.764672	0.000000	3.401580	.235170	.227699
45	3.560222	0.000000	3.401580	.097744	.088744
46	1.231118	0.000000	-1.530959	.146443	.154475
47	2.386670	0.000000	-1.530959	.157060	.165074
48	3.542222	0.000000	-1.530959	.080680	.093124
49	1.415654	0.000000	-1.998701	.212641	.224634

Figure 18.- Continued.

50	2.481184	0.000000	-1.998701	.447038	.475702
51	3.546721	0.000000	-1.498701	.406635	.371749
52	1.600170	0.000000	-2.466397	.405465	.610461
53	2.575497	0.000000	-2.466397	.492166	.520067
54	3.551224	0.000000	-2.466397	.357326	.285466
55	1.784662	0.000000	-2.434030	.609257	.556462
56	2.670193	0.000000	-2.434030	.494094	.488468
57	3.555723	0.000000	-2.434030	.270462	.202444
58	1.969121	0.000000	-3.401580	.561416	.540084
59	2.744672	0.000000	-3.401580	.331799	.442444
60	3.560222	0.000000	-3.401580	.196496	.182664

# LOADING INFORMATION

MACH NUMBER = .17000E+01  
 ANGLE OF ATTACK = 10.000 DEGREES  
 SIDE SLIP ANGLE = 10.000 DEGREES  
 WING AREA = 11.000000  
 REFERENCE AREA = 5.30929  
 REFERENCE LENGTH = 2.00000  
 EXPOSED WING SPAN H = 0.00000  
 MOMENT CENTER X = 10.50000  
 Z = 0.00000

## BERNOULLI TYPE LOADING PRESSURE

REF. ANGLE DEG.	TOTAL	FIN 1 OR B	FIN 2 OR L	FIN 3 OR U	FIN 4 OR D	INTERF. SHELL
CTHP =	.2947E+01	0.00000	0.00000	0.00000	0.00000	
CZ =	.10099E+01	.10504E+01	.43780E+02	.43764E+02	.10546E+01	
CY =	-.10099E+01	.58324E+00	.27494E+00	0.	0.	.15172E+00
CH =	-.00635E+01	0.	0.	.27086E+00	.58325E+00	-.15171E+00
CLH =	.42624E+01	.39542E+01	.18559E+01	0.	0.	-.10527E+01
CLL =	.00547E+04	0.	0.	.18554E+01	.18543E+01	.10527E+01
		-.50701E+00	.26086E+00	-.26079E+00	.50702E+00	.47696E-1A

## FOLLOWING ARE IN WIND-AXIS SYSTEM

CL =	.13914E+01	.40237E+00	.18953E+00	.18944E+00	.40234E+00	.20799E+00
CYALIND =	.59651E+04	.41241E+00	.19441E+00	-.19436E+00	-.41242E+00	.99701E+05
CUT =	.32179E+00	.01050E+01	.43500E+01	.43487E+01	.01050E+01	.52691E+01
CDI/CL+2 =	.10015E+00	0.	0.	0.	0.	0.
CYALIND =	-.07054E+01	-.27960E+01	-.13123E+01	-.13120E+01	-.27961E+01	-.14444E+01
CLALIND =	-.41231E+03	-.25859E+01	-.13362E+01	.13358E+01	.25860E+01	-.66543E+04

NOTE: I.E. OF LEAD PANEL IN FIRST COLUMNISE ROW IS SUPERSONIC

Figure 18.- Continued.

-----RIGHT -ING-----

## SPANWISE DISTRIBUTIONS

I	Y/(H/2)	CN*C/(2*H)	CF*C/(2*H)	CY1*C/(2*H)	CYTOT*C/(2*H)	CS*C/(2*H)	CSINT	YHAR	GAMMAET(I)	GAMMA,LE/VINF	XLE
1	.65426	.17051	0.00000	0.00000	.00017	0.00000	0.00000	0.00000	-.79887	0.00000	.13334
2	.85415	.16738	0.00000	0.00000	.00207	0.00000	0.00000	0.00000	.01460	0.00000	.40340
3	1.05402	.14747	0.00000	0.00000	.00146	0.00000	0.00000	0.00000	.09361	0.00000	.67342
4	1.25388	.12736	0.00000	0.00000	.00146	0.00000	0.00000	0.00000	.09411	0.00000	.94341
5	1.45367	.09399	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.15623	0.00000	1.21335
6	1.55556	0.00000							.44032		

SUMFY = 0.  
 SUMFY1 = 0.  
 SUMFY2 = .42571E+02  
 SUMFT2 = .24266E+01

## SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(1/2)*TIPCHORD	GAMMA,SE /VINF	YHAR	XSE
1	1	.53333	.00566	.00045	3.64000	1.45100
2	2	.65667	.03368	.00662	3.64000	2.10067
3	3	1.00000	.03901	.01354	3.64000	2.85033

\*\*\*\*T.E. FIN VORTEX INFO\*\*\*\*

IVRT GAMMA/VINF Y.C.G.

1 .79846 3.23908

----- LEFT WING-----

# SPANWISE DISTRIBUTION

I	Y/(R/2)	CX/C/(2*B)	CT/C/(2*B)	CY1/C/(2*B)	CYTOT/C/(2*B)	CS/C/(2*B)	CSINT	YBAR	GAMMA(T)	GAMMA,LE/VINF	XLE
7	-.65426	.04819	0.00000	0.00000	-.00150	0.00000	0.00000	0.00000	.22543	0.00000	.13334
8	-.65415	.06031	0.00000	0.00000	-.00056	0.00000	0.00000	0.00000	.05680	0.00000	.40340
9	-1.05402	.07455	0.00000	0.00000	-.00007	0.00000	0.00000	0.00000	.06811	0.00000	.67342
10	-1.25386	.08147	0.00000	0.00000	-.00006	0.00000	0.00000	0.00000	.03293	0.00000	.94341
11	-1.45367	.06801	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.06486	0.00000	1.21335
12	-1.55556	0.00000							-.31864		

SUMFX = 0.  
 SUMFY1 = 0.  
 SUMFY2 = -.22984E-02  
 SUMFT2 = -.21352E-01

# SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SECTION FORCE PER UNIT LENGTH /10*TIPCHORD	GAMMA,SE /VINF	YBAR	XSE
1	1	.33333	-.00602	-.00107	-3.64000	1.35100
2	2	.66667	-.03334	-.00698	-3.64000	2.10007
3	3	1.00000	-.02787	-.01193	-3.64000	2.85033

\*\*\*\*T.F. FIN VORTEX J-FIN\*\*\*\*

IVRT GAMMA/VINF , X.C.G.

2	.15764	-2.18595
3	-.38316	-3.56077

Figure 18.- Continued.

-----UPPER ATTC-----

## SPANWISE DISTRIBUTIONS--

I	Z/(R/2)	CN=C/(2*B)	CT=C/(2*B)	CZ1=C/(2*B)	CZTOT=C/(2*B)	CS=C/(2*B)	CSINT	ZBAR	SHIFT(1)	GAMMA, LE/VINF	XLE
13	.65426	.04817	0.00000	0.00000	.00150	0.00000	0.00000	0.00000	-.22554	0.00000	.13334
14	.85415	.06029	0.00000	0.00000	.00056	0.00000	0.00000	0.00000	-.05678	0.00000	.40340
15	1.05402	.07483	0.00000	0.00000	.00007	0.00000	0.00000	0.00000	-.04811	0.00000	.67342
16	1.25386	.08185	0.00000	0.00000	.00086	0.00000	0.00000	0.00000	-.03296	0.00000	.94341
17	1.45367	.08800	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.06481	0.00000	1.21335
18	1.55555	0.00000							.31859		

SUMFX = 0.  
 SUMFZ1 = 0.  
 SUMFZ2 = .22974E-02  
 SUMFT2 = .21349E-01

## SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(0*TIPCHORD)	GAMMA, SE /VINF	ZBAR	XSE
1	4	.33333	.00602	.00107	3.64000	1.35100
2	5	.66667	.03334	.00698	3.64000	2.10167
3	6	1.00000	.02787	.01193	3.64000	2.85033

\*\*\*\*\*E. FIN VORTEX INFO\*\*\*\*\*

IVRT GAMMA/VINF Z.C.G.

4 =.19764 2.16521  
 5 .38107 3.56081

Figure 18.- Continued.

-----LOWEN WING-----

# SPANWISE DISTRIBUTIONS

I	Z/(R/2)	CN=C/(2*B)	CT=C/(2*B)	CZ1=C/(2*B)	CZTIT=C/(2*B)	CS=C/(2*B)	CSINT	ZBAR	GAMMA(I)	GAMMA,LE/VINF	YLF
19	-.65426	.17061	0.00000	0.00000	-.00017	0.00000	0.00000	0.00000	.79448	0.00000	.13334
20	-.45015	.16718	0.00000	0.00000	-.00207	0.00000	0.00000	0.00000	-.01460	0.00000	.40340
21	-1.05402	.14747	0.00000	0.00000	-.00146	0.00000	0.00000	0.00000	-.09361	0.00000	.67342
22	-1.25386	.12756	0.00000	0.00000	-.00146	0.00000	0.00000	0.00000	-.09411	0.00000	.94341
23	-1.45367	.09399	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.15423	0.00000	1.21335
24	-1.55556	0.00000							-.44033		

SUMFX = 0.  
 SUMFZ1 = 0.  
 SUMFZ2 = -.42571E-02  
 SUMFT2 = -.24247E-01

# SIDE EDGE DISTRIBUTION

JTIP	JSE	DISTANCE FROM LE /TIPCHORD	SUCTION FORCE PER UNIT LENGTH /TIPCHORD	GAMMA,SE /VINF	ZBAR	XSE
1	7	.33333	-.00366	-.00065	-3.64000	1.35100
2	8	.66667	-.03368	-.00642	-3.64000	2.10067
3	9	1.00000	-.03901	-.01354	-3.64000	2.85033

\*\*\*\*E, FIN VORTEX INFO\*\*\*\*

IVRT GAMMA/VINF Z.C.G.

A -.79447 -1.23910

\*\*\*\*\*  
 AFT OF LEADING EDGE OF FIN QUOTCHORDS

## PRESSURE COEFFICIENTS AT POINTS ON BODY MERIDIANS

S	THETA, DEG.	XH	YH	ZH	UTOT	VTOT	WTOT	CP, LIN.	CP, HERN.	OR/DX	P/DINF, HERN.	P/DINF, LIN.
BODY RING# 1												
1	11.25000	36.54000	1.25052	.24874	.08210	.13852	.01640	-.1643A	-.12894	0.00000	.73915	.66747
2	33.75000	36.54000	1.06014	.70836	.01475	.05202	.03127	-.02949	-.02949	0.00000	.91955	.94034
3	56.25000	36.54000	.70836	1.06014	-.02427	.06871	-.10981	.04655	.09578	0.00000	1.19375	1.09416
4	78.75000	36.54000	.24874	1.25052	-.03442	.11770	-.16598	.06884	.13393	0.00000	1.27093	1.13926
5	101.25000	36.54000	-.24874	1.25052	.01842	.17193	-.18030	-.04685	.02463	0.00000	1.04982	.92546
6	123.75000	36.54000	-.70836	1.06014	-.06634	.18091	-.17097	.01267	.07637	0.00000	1.15449	1.02562
7	146.25000	36.54000	-1.06014	.70836	-.08633	.17099	-.18087	.01266	.07636	0.00000	1.15448	1.02562
8	168.75000	36.54000	-1.25052	.24874	.01844	.18031	-.17190	-.03688	.02460	0.00000	1.04977	.92540
9	191.25000	36.54000	-1.25052	-.24874	-.03443	.16598	-.17169	.06887	.13396	0.00000	1.27099	1.13932
10	213.75000	36.54000	-1.06014	-.70836	-.07328	.10984	-.06876	.04655	.09580	0.00000	1.19381	1.09418
11	236.25000	36.54000	-.70836	-1.06014	.01475	-.03123	-.03205	-.02949	-.02986	0.00000	.93959	.94034
12	258.75000	36.54000	-.24874	-1.25052	.08219	-.01634	-.13852	-.16437	-.12894	0.00000	.73916	.66747
13	281.25000	36.54000	.24874	-1.25052	-.08828	.06821	-.20246	.14656	.26977	0.00000	1.54575	1.39765
14	303.75000	36.54000	.70836	-1.06014	-.04277	.15795	-.19643	.08555	.15552	0.00000	1.31462	1.17307
15	326.25000	36.54000	1.06014	-.70836	-.04277	.19642	-.15796	.08555	.15552	0.00000	1.31462	1.17307
16	348.75000	36.54000	1.25052	-.24874	-.09828	.20246	-.06821	.14656	.26977	0.00000	1.54575	1.39765
BODY RING# 2												
1	11.25000	37.74000	1.25052	.24874	.09340	.14188	.00241	-.18680	-.14353	0.00000	.76965	.62210
2	33.75000	37.74000	1.06014	.70836	.05033	.06741	-.02045	-.10067	-.07064	0.00000	.85710	.79635
3	56.25000	37.74000	.70836	1.06014	-.00353	.07450	-.11789	.00705	.05716	0.00000	1.11564	1.01427
4	78.75000	37.74000	.24874	1.25052	-.03836	.12796	-.16918	.07671	.14399	0.00000	1.29128	1.15519
5	101.25000	37.74000	-.24874	1.25052	.03431	.19227	-.17615	-.06661	-.00789	0.00000	.98444	.84120
6	123.75000	37.74000	-.70836	1.06014	.02468	.21202	-.14964	.00988	.00988	0.00000	1.01908	.90016
7	146.25000	37.74000	-1.06014	.70836	.02468	.14967	-.21198	-.04937	.00987	0.00000	1.01907	.90013
8	168.75000	37.74000	-1.25052	.24874	.03432	.17615	-.19224	-.06664	-.00771	0.00000	.98439	.86114
9	191.25000	37.74000	-1.25052	-.24874	-.03837	.16918	.12799	.07674	.14402	0.00000	1.29135	1.15525
10	213.75000	37.74000	-1.06014	-.70836	-.00354	.11774	-.07857	.00708	.05721	0.00000	1.11573	1.01431
11	236.25000	37.74000	-.70836	-1.06014	.05034	.02044	-.06743	-.10066	-.07062	0.00000	.85714	.79636
12	258.75000	37.74000	-.24874	-1.25052	.09340	-.02330	-.14188	-.18680	-.14352	0.00000	.76965	.62210
13	281.25000	37.74000	.24874	-1.25052	-.11208	.05872	-.20464	.22416	.29970	0.00000	1.60630	1.45348
14	303.75000	37.74000	.70836	-1.06014	-.12123	.14059	-.20823	.24245	.33892	0.00000	1.88564	1.49048
15	326.25000	37.74000	1.06014	-.70836	-.12122	.20823	-.14060	.24245	.33892	0.00000	1.88564	1.49048
16	348.75000	37.74000	1.25052	-.24874	-.11208	.20464	-.05872	.22416	.29970	0.00000	1.60630	1.45348
BODY RING# 3												
1	11.25000	38.94000	1.25052	.24874	.10902	.15137	-.04299	-.21804	-.15818	0.00000	.68000	.55880
2	33.75000	38.94000	1.06014	.70836	.03374	.07774	-.02726	-.04749	-.03683	0.00000	.92549	.84297
3	56.25000	38.94000	.70836	1.06014	.00734	.08662	-.12365	.03689	.01469	0.00000	1.07409	.98029
4	78.75000	38.94000	.24874	1.25052	.03709	.08564	-.16211	-.07418	-.02054	0.00000	.94445	.84994
5	101.25000	38.94000	-.24874	1.25052	.08829	.23668	-.16751	-.17657	-.11217	0.00000	.77308	.66280
6	123.75000	38.94000	-.70836	1.06014	.05310	.20442	-.15419	-.10638	-.04540	0.00000	.94816	.78479
7	146.25000	38.94000	-1.06014	.70836	.05310	.15421	-.20438	-.10638	-.04539	0.00000	.94817	.78479
8	168.75000	38.94000	-1.25052	.24874	.08829	.16751	-.23665	-.17657	-.11217	0.00000	.77309	.66279
9	191.25000	38.94000	-1.25052	-.24874	.03708	.16211	-.08567	-.07416	-.02052	0.00000	.94448	.84997
10	213.75000	38.94000	-1.06014	-.70836	.00733	.12369	-.08668	-.01467	.03692	0.00000	1.07469	.97032

Figure 18.- Continued.

11	246,25000	38,94000	-.70836	-1,06014	.03373	.02729	-.07281	-.04747	-.03640	0,00000	.92555	.86351
12	254,75000	38,94000	-.24874	-1,25052	.10902	.04299	-.15137	-.21803	-.15817	0,00000	.68002	.55892
13	281,25000	38,94000	.24874	-1,25052	-.09663	-.00224	-.21700	.19326	.23784	0,00000	1,48116	1,39096
14	303,75000	38,94000	.70836	-1,06014	-.15488	.13903	-.20945	.30977	.42275	0,00000	1,85523	1,62666
15	326,25000	38,94000	1,06014	-.70836	-.15488	.20944	-.13904	.30977	.42275	0,00000	1,85523	1,62666
16	344,75000	38,94000	1,25052	-.24874	-.09663	.21700	.00223	.19325	.23784	0,00000	1,48115	1,39095

Figure 18.- Concluded.



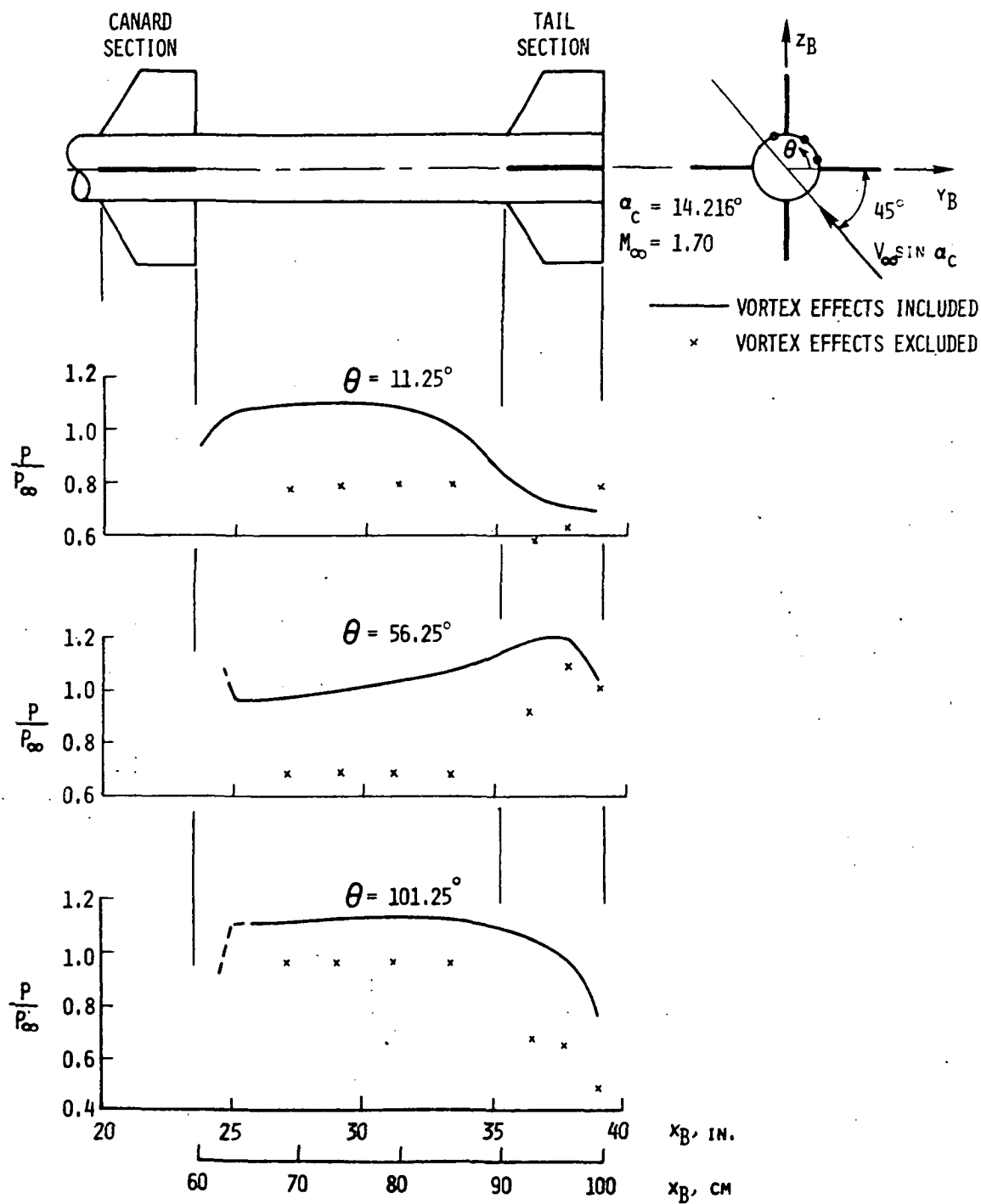


Figure 19.- Calculated pressure distributions along body meridians from canard section to body base, first sample case, step 6.

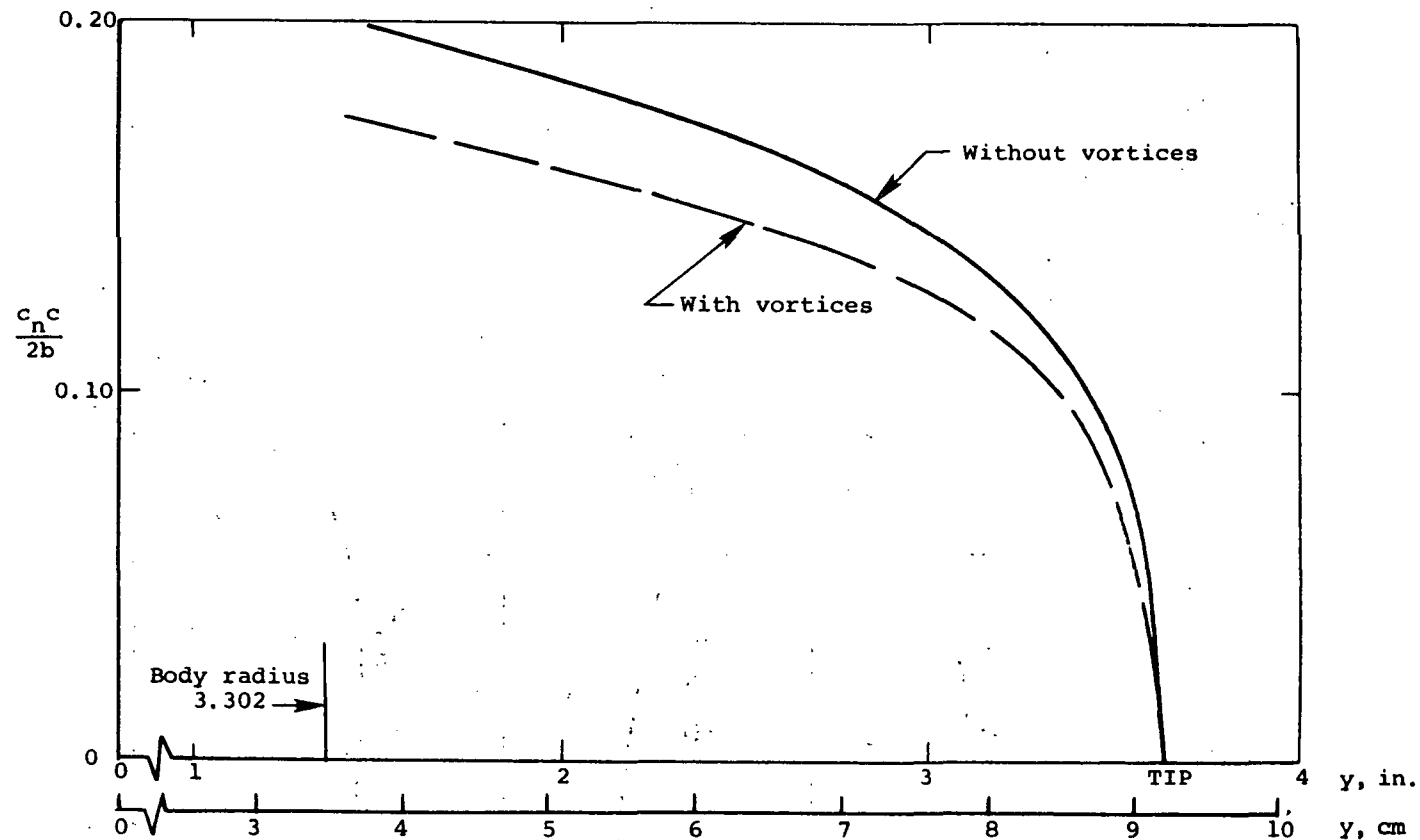


Figure 20.- Calculated span load distribution on right horizontal tail fin, first sample case, step 6.

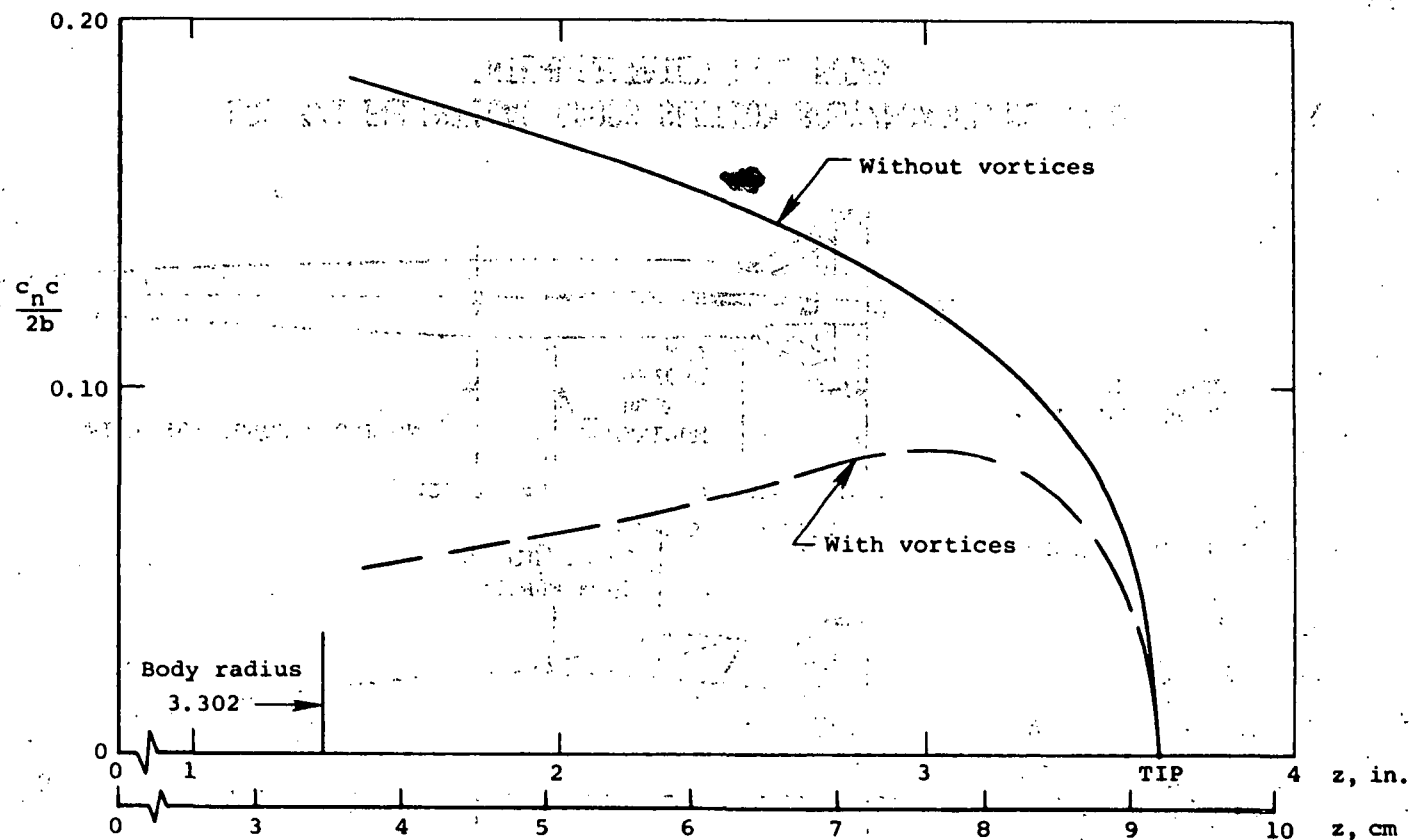
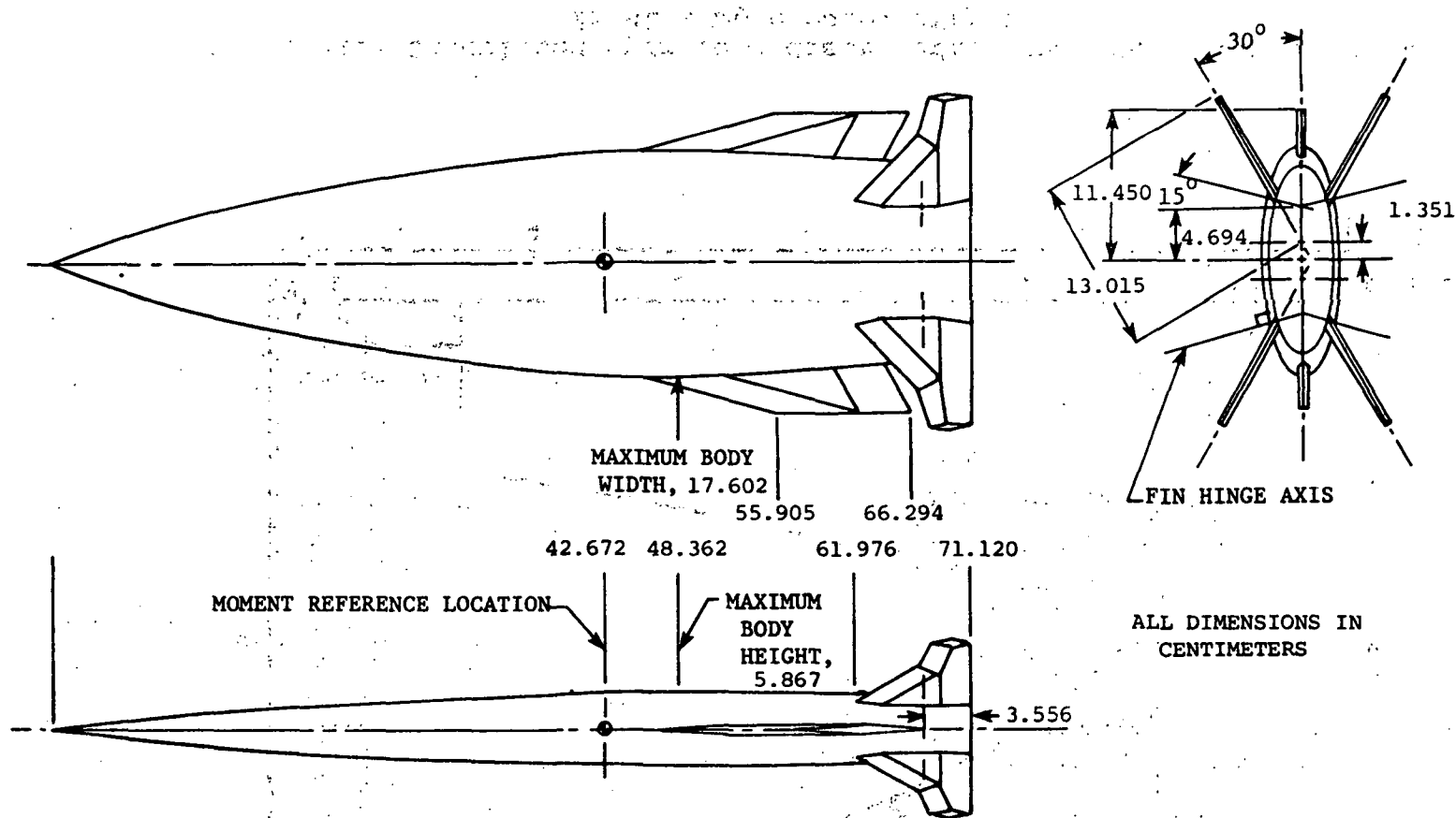


Figure 21.- Calculated span-load distribution on upper vertical fin, first sample case, step 6.



LRC 3/1 ELLIPTICAL CROSS SECTION BODY/MONOPLANE WING/  
INTERDIGITATED TAIL MODEL

Figure 22.- Configuration used for second sample case.

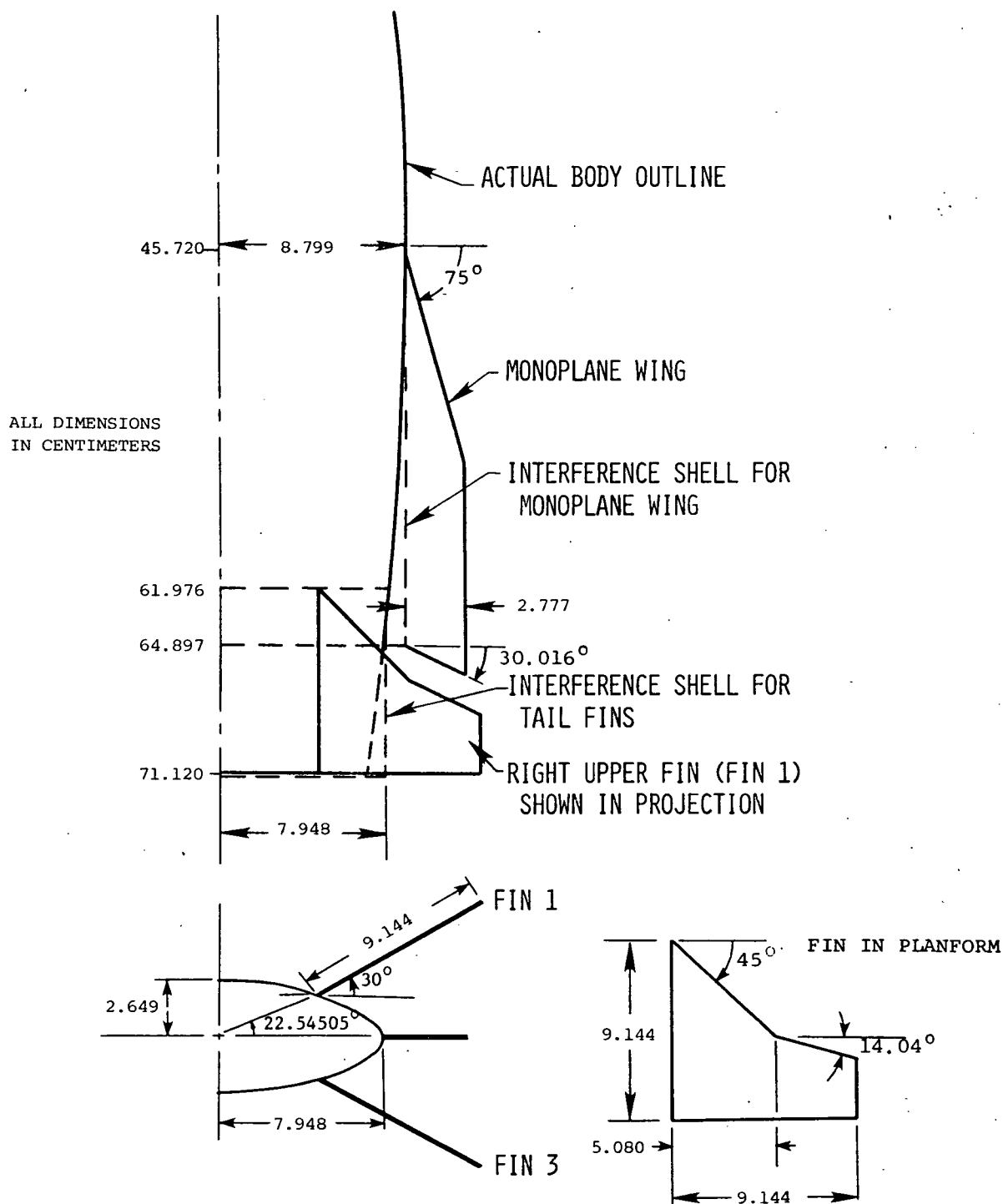
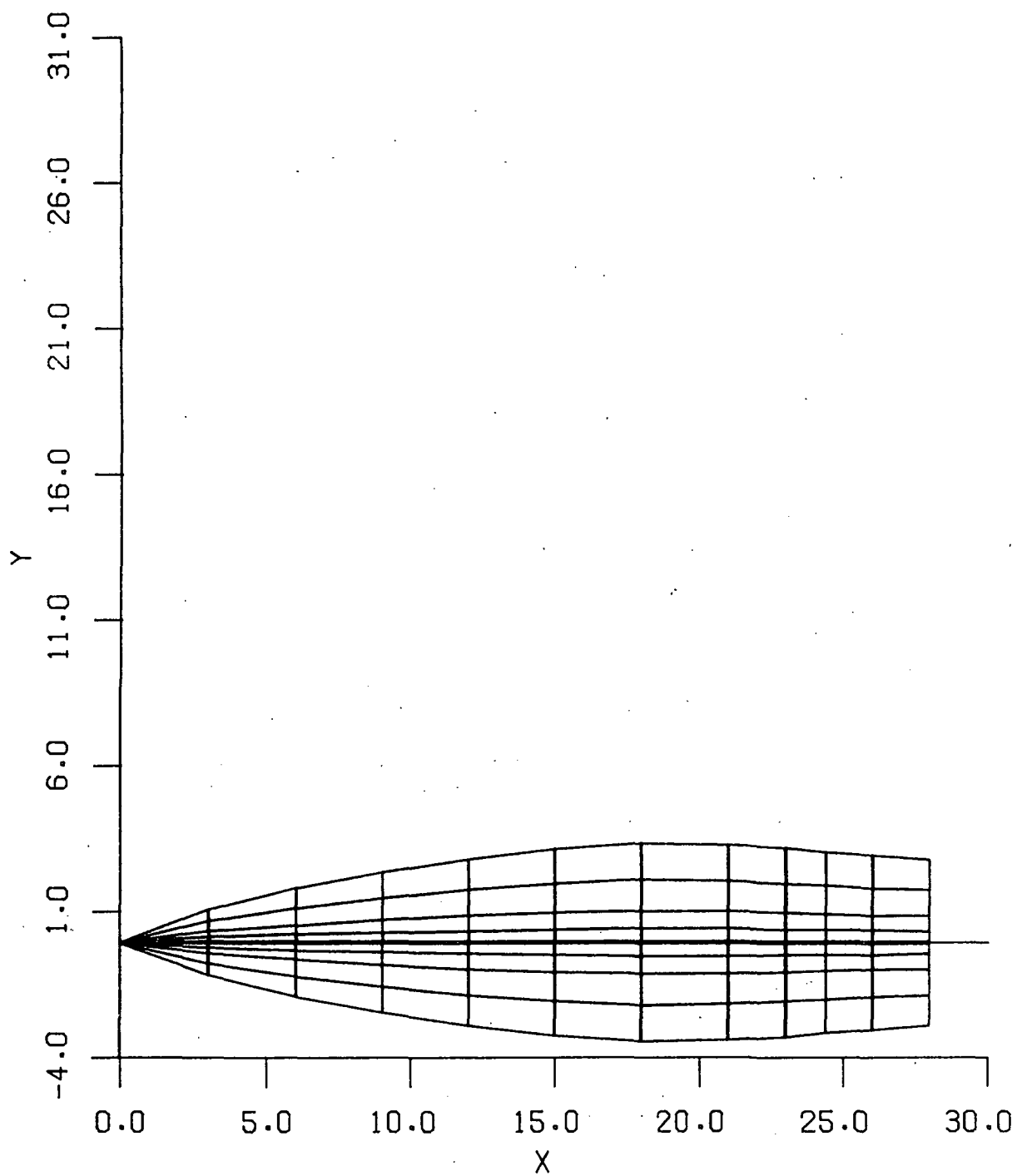
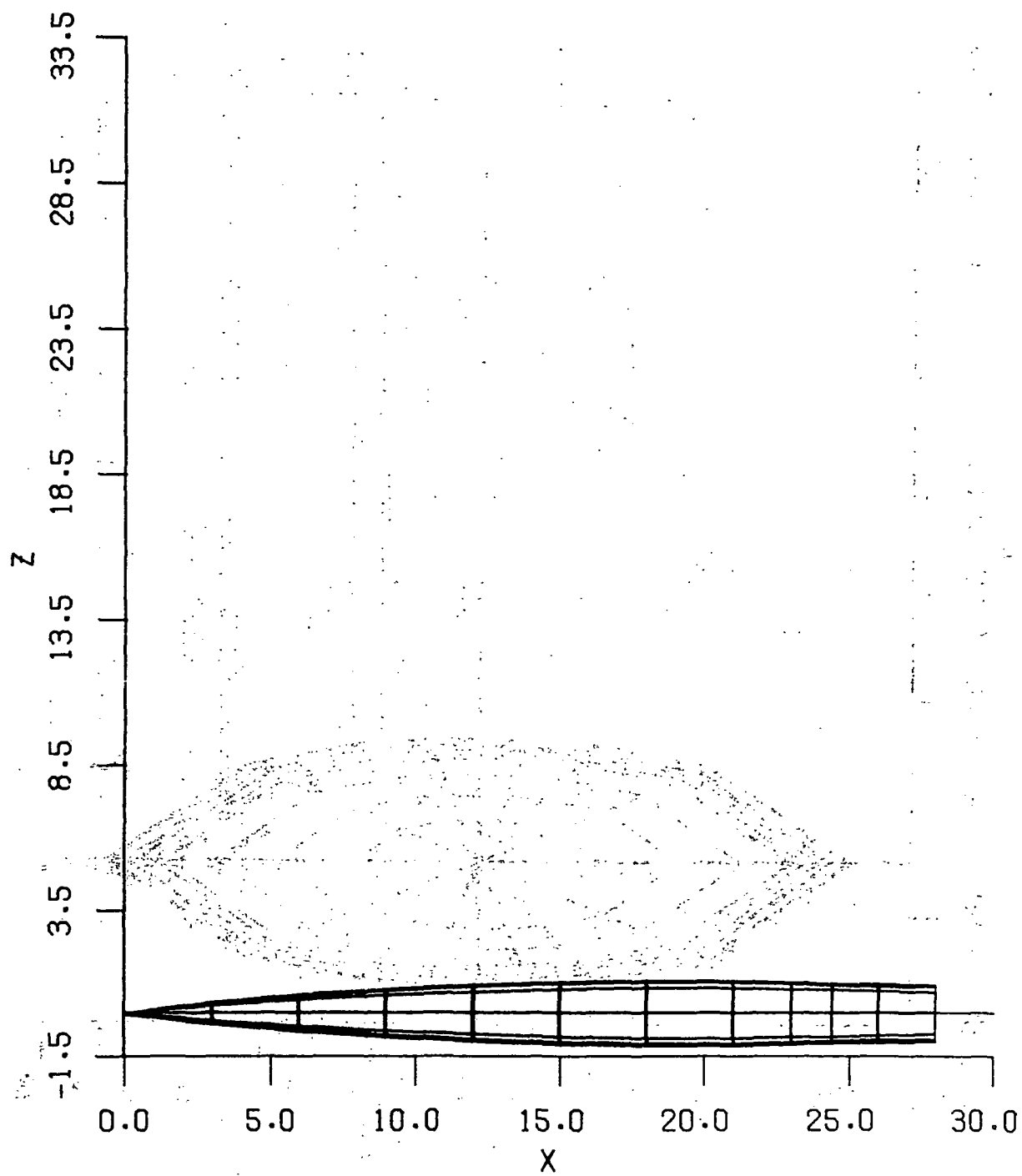


Figure 23.- Geometrical details, idealizations of configuration used for second sample case.



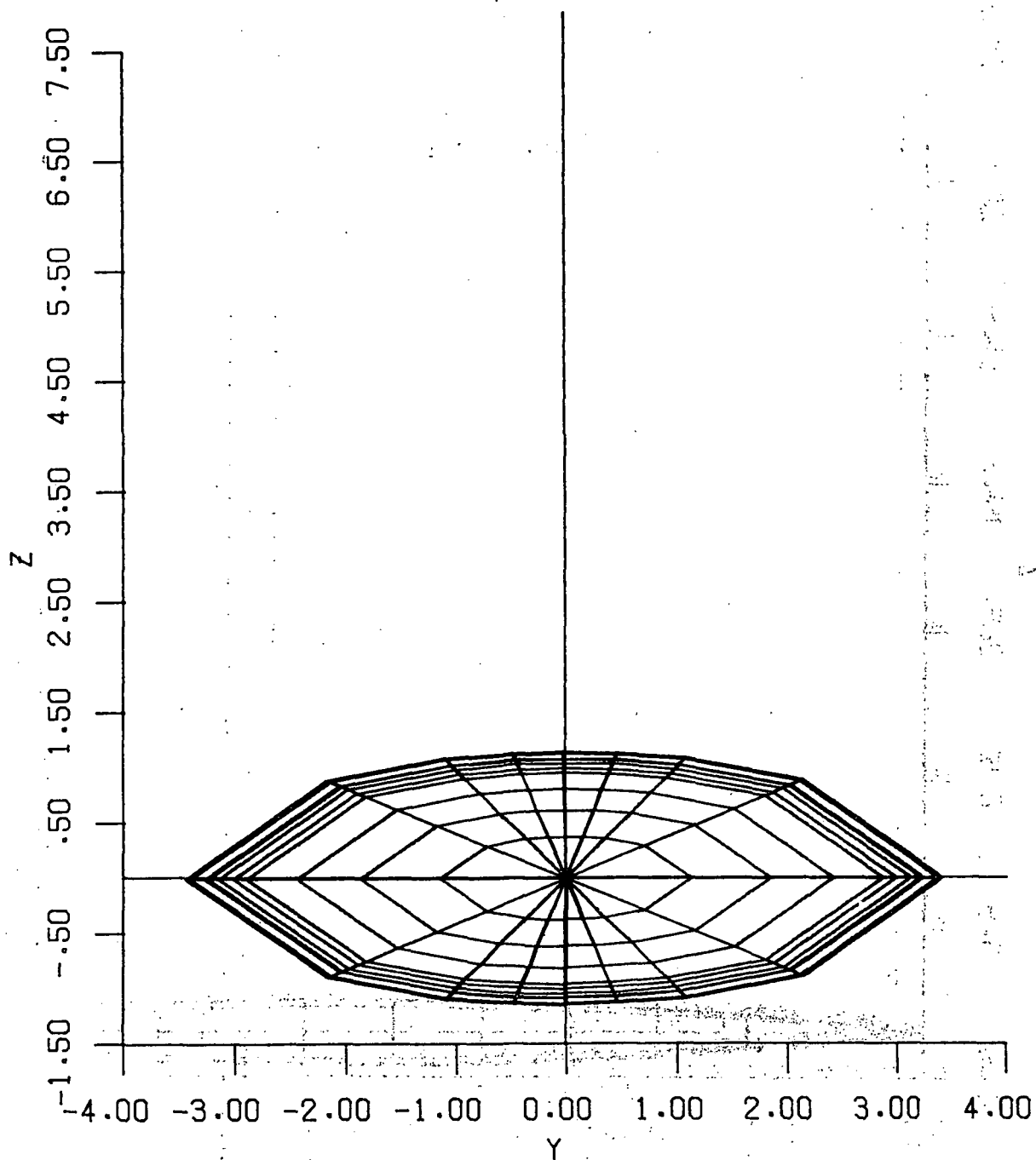
(a) Plan View

Figure 24.- Body source paneling layout, second sample case.



(b) Elevation

Figure 24.- Continued.



(c) End View

Figure 24.- Concluded.



```

LRC 3/1 ELLIPTIC WING/BODY MISSILE CONFIGURATION - NOSE VORTICITY
  1  0  0  0  0  0  0  0  0  0  0  22  2  10  0
18.0  0.0
  0  0 -3  0  0  0 -1  0  0  1  13  30  0  0  0  0  0  0  0  0  0  0
  0.000  .420  .700  2.100  3.500  4.900  5.600  6.300  7.700  8.400
  9.100 10.500 11.900 12.600 13.300 14.700 15.400 16.800 17.500 18.200
 19.040 19.600 20.300 21.000 22.400 23.100 24.500 25.900 26.600 28.000
 0.0000  .2675  .3914  .8808  1.2745  1.6168  1.7736  1.9222  2.1978  2.3256
 2.4471  2.6721  2.8735  2.9653  3.0510  3.2033  3.2692  3.3777  3.4184  3.4481
 3.4641  3.4563  3.4322  3.3970  3.3029  3.2476  3.1283  3.0090  2.9552  2.8846
 0.0000  .0892  .1305  .2936  .4248  .5389  .5912  .6407  .7326  .7752
 .8157  .8907  .9578  .9884  1.0170  1.0678  1.0897  1.1259  1.1395  1.1494
 1.1547  1.1521  1.1441  1.1323  1.1010  1.0825  1.0428  1.0030  .9851  .9615
ELLIPTIC BODY PANELING - KRAD=9, KFORX=11
  0  0 -2
  1  0  1  0  0  0 -1  0  0  1  9  11  0  0  0  0  0  0
12.567 3.4641 16.8
 0.0 2.0 4.0 6.0 8.0 10. 12. 14. 16. 18.
 0.000 3.000 6.000 9.000 12.00 15.00 18.00 21.00 23.00 24.40
25.6
 1.70 10.
 0.0 .653 .990 1.281 1.528 1.7465 1.932 2.1 2.24 2.35
 0.0 .299 .531 .739 .929 1.1028 1.272 1.423 1.551 1.673
 0.0 .191 .4725 .675 .851 1.008 1.151 1.283 1.406 1.52
 0.0 -.653 -.990 -1.281 -1.528 -1.7465 -1.932 -2.1 -2.24 -2.35
 0.0 .299 .531 .739 .929 1.1028 1.272 1.423 1.551 1.673
 0.0 -.191 -.4725 -.675 -.851 -1.008 -1.151 -1.283 -1.406 -1.52
-1.0

```

IPRT  
XWLE  
OJCARD  
XFUS  
XFUS  
XFUS  
FUSBY  
FUSBY  
FUSBY  
FUSAZ  
FUSAZ  
FUSAZ  
BC/PRINT  
KCARD  
REF  
XV  
XFUS10  
XFUS11  
MALPHA  
YVRTX1  
ZVRTX1  
GAM1  
YVRTX2  
ZVRTX2  
GAM2

Figure 25.- Input of program WDYBDY, second sample case, step 2.

LIST OF INPUT CARDS

```

LRC 3/1 ELLIPTIC WING/BODY MISSILE CONFIGURATION = NOSE VORTICITY
1 0 0 0 0 0 0 0 0 0 22 2 10 0
1A.0 0.0
0 0 -3 0 0 0 -1 0 0 1 13 30 0 0 0 0 0 0 0 0 0 0 0
0.000 .420 .700 2.100 3.500 4.900 5.600 6.300 7.700 8.400
9.100 10.500 11.900 12.600 13.300 14.700 15.400 16.800 17.500 18.200
19.040 19.600 20.300 21.000 22.400 23.100 24.500 25.900 26.600 28.000
0.0000 .2675 .3914 .4808 1.2745 1.6168 1.7736 1.9222 2.1978 2.3256
2.4471 2.6721 2.8735 2.9653 3.0510 3.2033 3.2692 3.3777 3.4180 3.4481
3.4641 3.4563 3.4322 3.3970 3.3029 3.2476 3.1283 3.0090 2.9552 2.8846
0.0000 .0892 .1305 .2936 .4248 .5349 .5912 .6407 .7326 .7752
.8157 .8907 .9578 .9884 1.0170 1.0678 1.0897 1.1259 1.1395 1.1494
1.1547 1.1521 1.1441 1.1323 1.1010 1.0825 1.0428 1.0030 .9851 .9615
ELLIPTIC BODY PANELING = KRAD=9, KFORX=11
0 0 -2
1 0 1 0 0 0 -1 0 0 1 9 11 0 0 0 0 0 0
12.567 4.4641 16.8
0.0 2.0 4.0 6.0 8.0 10. 12. 14. 16. 18.
0.000 3.000 6.000 9.000 12.00 15.00 18.00 21.00 23.00 24.40
25.6
1.70 10.
0.0 .653 .990 1.281 1.528 1.7465 1.932 2.1 2.24 2.35
0.0 .299 .531 .739 .929 1.1028 1.272 1.423 1.551 1.673
0.0 .191 .4725 .675 .851 1.008 1.151 1.283 1.406 1.52
0.0 -.653 -.990 -1.281 -1.528 -1.7465 -1.932 -2.1 -2.24 -2.35
0.0 .299 .531 .739 .929 1.1028 1.272 1.423 1.551 1.673
0.0 -.191 -.4725 -.675 -.851 -1.008 -1.151 -1.283 -1.406 -1.52
-1.0

```

BEGIN A NEW CONFIGURATION

\*\* WDYBDY \*\*

LRC 3/1 ELLIPTIC WING/BODY MISSILE CONFIGURATION = NOSE VORTICITY

\*\* GFM \*\*

ADDITIONAL PRINT OPTIONS (IPRT) + XZ=PLANE SYMMETRY

TV GENM VORTEX VEL SOLN IXZSYM  
1 0 0 0 0 0

PLNT OPTIONS (IPLNT)

GENM CP U/V/W  
0 0 0 0

Figure 26.- Output of program WDYBDY, second sample case, step 2.

VORTEX CALCULATION CONTROL  
 N=CPT NVTX NVVIX NCPDUT NVLIN  
 22 2 10 0 0

X=LE Y=7407  
 18.000 0.000

J=DATA CARDS REQUIRED (NO=0,YES=1)

OFFA	WING	BODY	PINN	V.FIN	M.TAIL	YY=SYM
J0	J1	J2	J3	J4	J5	J6
0	0	-3	0	0	0	-1

WING GEOM:	NWAFS	0	NWAFOR	0
BODY GEOM: <th>NFUS</th> <th>1</th> <th>NRADX</th> <th>13 0 0 0</th>	NFUS	1	NRADX	13 0 0 0
			NFOR	30 0 0 0
PINN GEOM: <th>AP</th> <th>0</th> <th>NPINOR</th> <th>0</th>	AP	0	NPINOR	0
V.FIN GEOM: <th>NF</th> <th>0</th> <th>NFINOR</th> <th>0</th>	NF	0	NFINOR	0
M.TAIL GEOM: <th>NCAN</th> <th>0</th> <th>NCANOR</th> <th>0</th>	NCAN	0	NCANOR	0

VEHICLE GEOMETRY DEFINITION  
 REFERENCE AREA (J0,GT,0) REFAR 1.00000

.. CONFIG ..

NPU	XFUS	FUSFLAGE	X-STATIONS
1	0.0000	.4200	.7000
1	9.1000	10.5000	11.9000
1	19.0000	19.6000	20.1000
			21.0000
			22.0000
			23.1000
			24.5000
			25.9000
			26.6000
			28.0000

NPU	FUSRY	ELLIPTIC FUSELAGE	SEMI-MAJOR AXIS
1	0.0000	.2675	.3010
1	2.0071	2.6721	2.8735
1	3.4641	3.4563	3.4322
			3.3970
			3.3029
			3.2476
			3.1243
			3.0090
			2.9552
			2.8846

NPU	FUSAZ	ELLIPTIC FUSELAGE	SEMI-MINOR AXIS
1	0.0000	.0002	.1505
1	.8157	.8907	.9578
1	1.1547	1.1521	1.1041
			1.1323
			1.1010
			1.0825
			1.0428
			1.0030
			.9851
			.9615

ELLIPTIC BODY PANELING - NWAFS=9, NFOR=11

.. GEOM ..

LINBC	THICK	PRINT	LCRA	LCPR	LCPC	ITMAX	CTEST
0	0	-2	0	0	0	0	0.00000

# K=DATA CARDS, ADDITIONAL CARDS FOR PANELING

REF	WING	BODY	N/A	V.FIN	M.TAIL	N/A
K0	K1	K2	K3	K4	K5	K6
1	0	1	0	0	0	-1

WING PANEL:	K=AFB	0	K=AFDR	0			
BODY PANEL:	K=USB	1	K=ADXB	9	0	0	0
			K=DRXB	11	0	0	0

PANEL REFERENCE LENGTHS						
REFAR	REFH	REFC	REFD	REFL	REFY	REFZ
12.567	0.000	0.000	3.464	0.000	16.800	0.000

## VORTEX LOCATIONS AND BODY AXES

.. READVX ..

	XVB	YVB	ZVB	XVB	YVB	ZVB	XVB	YVB	ZVB	XVB	YVB	ZVB
1	0.0000	2.0000	4.0000	6.0000	8.0000	10.0000	12.0000	14.0000	16.0000	18.0000		
2	0.0000	.8458	1.3968	1.8585	2.2526	2.5917	2.8864	3.1272	3.3157	3.4196		
3	0.0000	.2420	.4856	.6195	.7509	.8639	.9622	1.0424	1.1052	1.1466		

## BODY PANEL CURVED POINT COORDINATES

.. BODYPAN ..

1 AND 3 INDICATE BODY PANEL LEADING-EDGE POINTS, 2 AND 4 INDICATE TRAILING-EDGE POINTS

PANEL	1	2	3	4	1	2	3	4	1	2	3	4
1	0.00000	0.00000	0.00000	3.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.00000	0.00000	0.00000	3.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
3	0.00000	0.00000	0.00000	3.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4	0.00000	0.00000	0.00000	3.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5	0.00000	0.00000	0.00000	3.00000	1.13349	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00000	0.00000	3.00000	.71086	.29445	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7	0.00000	0.00000	0.00000	3.00000	.35855	.35855	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
8	0.00000	0.00000	0.00000	3.00000	.15508	.37439	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9	3.00000	.00000	-.37794	6.00000	.00000	-.61949	3.00000	.15508	-.37439	6.00000	.25419	-.61366
10	3.00000	.15508	-.37439	6.00000	.25419	-.61366	3.00000	.35855	-.35855	6.00000	.58770	-.58770
11	3.00000	.35855	-.35855	6.00000	.58770	-.58770	3.00000	.71086	-.29445	6.00000	1.16516	-.48263
12	3.00000	.71086	-.29445	6.00000	1.16516	-.48263	3.00000	1.13349	.00000	6.00000	1.85851	.00000
13	3.00000	1.13349	.00000	6.00000	1.85851	.00000	3.00000	.71086	.29445	6.00000	1.16516	.48263
14	3.00000	.71086	.29445	6.00000	1.16516	.48263	3.00000	.35855	.35855	6.00000	.58770	.58770
15	3.00000	.35855	.35855	6.00000	.58770	.58770	3.00000	.15508	.37439	6.00000	.25419	.61366
16	3.00000	.15508	.37439	6.00000	.25419	.61366	3.00000	.00000	.37794	6.00000	.00000	.61949
17	6.00000	.00000	-.61949	9.00000	.00000	-.80291	6.00000	.25419	-.61366	9.00000	.11232	-.80230
18	6.00000	.25419	-.61366	9.00000	.11232	-.80230	6.00000	.58770	-.58770	9.00000	.76835	-.76835
19	6.00000	.58770	-.58770	9.00000	.76835	-.76835	6.00000	1.16516	-.48263	9.00000	1.52331	-.63090
20	6.00000	1.16516	-.48263	9.00000	1.52331	-.63090	6.00000	1.85851	.00000	9.00000	2.02974	.00000

Figure 26.- Continued.

21	6.00000	1.45451	.00000	9.00000	2.42974	.00000	6.00000	1.16514	.48263	9.00000	1.52331	.63098
22	6.00000	1.16514	.48263	9.00000	1.52331	.63098	6.00000	.58770	.48770	9.00000	.78835	.78835
23	6.00000	.58770	.48770	9.00000	.78835	.78835	6.00000	.25419	.61366	9.00000	.33232	.80230
24	6.00000	.25419	.61366	9.00000	.33232	.80230	6.00000	-.00000	.61949	9.00000	-.00000	.80991
25	9.00000	.00000	-.40991	12.00000	.00000	-.96217	9.00000	.33232	-.80230	12.00000	.39480	-.95313
26	9.00000	.33232	-.80230	12.00000	.39480	-.95313	9.00000	.76835	-.76835	12.00000	.91280	-.91280
27	9.00000	.76835	-.76835	12.00000	.91280	-.91280	9.00000	1.52331	-.63098	12.00000	1.80970	-.74960
28	9.00000	1.52331	-.63098	12.00000	1.80970	-.74960	9.00000	2.42974	.00000	12.00000	2.88661	.00000
29	9.00000	2.42974	.00000	12.00000	2.88661	.00000	9.00000	1.52331	.63098	12.00000	1.80970	.74960
30	9.00000	1.52331	.63098	12.00000	1.80970	.74960	9.00000	.76835	.76835	12.00000	.91280	.91280
31	9.00000	.76835	.76835	12.00000	.91280	.91280	9.00000	.33232	.80230	12.00000	.39480	.95313
32	9.00000	.33232	.80230	12.00000	.39480	.95313	9.00000	-.00000	.80991	12.00000	-.00000	.96217
33	12.00000	.00000	-.46217	15.00000	.00000	-.1.07719	12.00000	.39480	-.95313	15.00000	.44199	-.1.06706
34	12.00000	.39480	-.95313	15.00000	.44199	-.1.06706	12.00000	.91280	-.91280	15.00000	1.02191	-.1.02191
35	12.00000	.91280	-.91280	15.00000	1.02191	-.1.02191	12.00000	1.80970	-.74960	15.00000	2.02600	-.83920
36	12.00000	1.80970	-.74960	15.00000	2.02600	-.83920	12.00000	2.88661	.00000	15.00000	3.23154	.00000
37	12.00000	2.88661	.00000	15.00000	3.23154	.00000	12.00000	1.80970	.74960	15.00000	2.02600	.83920
38	12.00000	1.80970	.74960	15.00000	2.02600	.83920	12.00000	.91280	.91280	15.00000	1.02191	1.02191
39	12.00000	.91280	.91280	15.00000	1.02191	1.02191	12.00000	.39480	.95313	15.00000	.44199	1.06706
40	12.00000	.39480	.95313	15.00000	.44199	1.06706	12.00000	-.00000	.96217	15.00000	-.00000	1.07719
41	15.00000	.00000	-.1.07719	18.00000	.00000	-.1.14657	15.00000	.44199	-.1.06706	18.00000	.47046	-.1.13580
42	15.00000	.44199	-.1.06706	18.00000	.47046	-.1.13580	15.00000	1.02191	-.1.02191	18.00000	1.08773	-.1.08773
43	15.00000	1.02191	-.1.02191	18.00000	1.08773	-.1.08773	15.00000	2.02600	-.83920	18.00000	2.15648	-.89324
44	15.00000	2.02600	-.83920	18.00000	2.15648	-.89324	15.00000	3.23154	.00000	18.00000	3.43961	.00000
45	15.00000	3.23154	.00000	18.00000	3.43961	.00000	15.00000	2.02600	.83920	18.00000	2.15648	.89324
46	15.00000	2.02600	.83920	18.00000	2.15648	.89324	15.00000	1.02191	1.02191	18.00000	1.08773	1.08773
47	15.00000	1.02191	1.02191	18.00000	1.08773	1.08773	15.00000	.44199	.1.06706	18.00000	.47046	1.13580
48	15.00000	.44199	.1.06706	18.00000	.47046	1.13580	15.00000	-.00000	1.07719	18.00000	-.00000	1.14657
49	18.00000	.00000	-.1.14657	21.00000	.00000	-.1.13230	18.00000	.47046	-.1.13580	21.00000	.46461	-.1.12166
50	18.00000	.47046	-.1.13580	21.00000	.46461	-.1.12166	18.00000	1.08773	-.1.08773	21.00000	1.07420	-.1.07420
51	18.00000	1.08773	-.1.08773	21.00000	1.07420	-.1.07420	18.00000	2.15648	-.89324	21.00000	2.12969	-.88215
52	18.00000	2.15648	-.89324	21.00000	2.12969	-.88215	18.00000	3.43961	.00000	21.00000	3.39700	.00000
53	18.00000	3.43961	.00000	21.00000	3.39700	.00000	18.00000	2.15648	.89324	21.00000	2.12969	.88215
54	18.00000	2.15648	.89324	21.00000	2.12969	.88215	18.00000	1.08773	1.08773	21.00000	1.07420	1.07420
55	18.00000	1.08773	1.08773	21.00000	1.07420	1.07420	18.00000	.47046	1.13580	21.00000	.46461	1.12166
56	18.00000	.47046	1.13580	21.00000	.46461	1.12166	18.00000	-.00000	1.14657	21.00000	-.00000	1.13230
57	21.00000	.00000	-.1.13230	23.00000	.00000	-.1.08514	21.00000	.46461	-.1.12166	23.00000	.44526	-.1.07495
58	21.00000	.46461	-.1.12166	23.00000	.44526	-.1.07495	21.00000	1.07420	-.1.07420	23.00000	1.02946	-.1.02946
59	21.00000	1.07420	-.1.07420	23.00000	1.02946	-.1.02946	21.00000	2.12969	-.88215	23.00000	2.04099	-.84540
60	21.00000	2.12969	-.88215	23.00000	2.04099	-.84540	21.00000	3.39700	.00000	23.00000	3.25550	.00000
61	21.00000	3.39700	.00000	23.00000	3.25550	.00000	21.00000	2.12969	.88215	23.00000	2.04099	.84540
62	21.00000	2.12969	.88215	23.00000	2.04099	.84540	21.00000	1.07420	1.07420	23.00000	1.02946	1.02946
63	21.00000	1.07420	1.07420	23.00000	1.02946	1.02946	21.00000	.46461	1.12166	23.00000	.44526	1.07495
64	21.00000	.46461	1.12166	23.00000	.44526	1.07495	21.00000	-.00000	1.13230	23.00000	-.00000	1.08514
65	23.00000	.00000	-.1.08514	24.00000	.00000	-.1.04564	23.00000	.44526	-.1.07495	24.00000	.42905	-.1.03581
66	23.00000	.44526	-.1.07495	24.00000	.42905	-.1.03581	23.00000	1.02946	-.1.02946	24.00000	.99197	-.99197
67	23.00000	1.02946	-.1.02946	24.00000	.99197	-.99197	23.00000	2.04099	-.84540	24.00000	1.96664	-.81461
68	23.00000	2.04099	-.84540	24.00000	1.96664	-.81461	23.00000	3.25550	.00000	24.00000	3.13682	.00000
69	23.00000	3.25550	.00000	24.00000	3.13682	.00000	23.00000	2.04099	.84540	24.00000	1.96664	.81461
70	23.00000	2.04099	.84540	24.00000	1.96664	.81461	23.00000	1.02946	1.02946	24.00000	.99197	.99197
71	23.00000	1.02946	1.02946	24.00000	.99197	.99197	23.00000	.44526	1.07495	24.00000	.42905	1.03581
72	23.00000	.44526	1.07495	24.00000	.42905	1.03581	23.00000	-.00000	1.08514	24.00000	-.00000	1.04564

Figure 26.- Continued.

73	24.40000	.00000	-1.04564	25.60000	.00000	-1.01153	24.40000	.42905	-1.03581	25.60000	.41505	-1.00202
74	24.40000	.42905	-1.03581	25.60000	.41505	-1.00202	24.40000	.99197	-1.03581	25.60000	.95962	-1.00202
75	24.40000	.99197	-1.03581	25.60000	.95962	-1.00202	24.40000	1.96644	-1.03581	25.60000	1.90251	-1.00202
76	24.40000	1.96644	-1.03581	25.60000	1.90251	-1.00202	24.40000	3.13632	-1.03581	25.60000	3.03456	-1.00202
77	24.40000	3.13632	-1.03581	25.60000	3.03456	-1.00202	24.40000	1.96644	-1.03581	25.60000	1.90251	-1.00202
78	24.40000	1.96644	-1.03581	25.60000	1.90251	-1.00202	24.40000	.99197	-1.03581	25.60000	.95962	-1.00202
79	24.40000	.99197	-1.03581	25.60000	.95962	-1.00202	24.40000	.42905	-1.03581	25.60000	.41505	-1.00202
80	24.40000	.42905	-1.03581	25.60000	.41505	-1.00202	24.40000	.00000	-1.03581	25.60000	.00000	-1.00202

# BODY PANEL CENTROID POINT COORDINATES

POINT	X	Y	Z
	CP	CP	CP
1	2.00000	.05169	-.25078
2	2.00000	.17121	-.24431
3	2.00000	.35447	-.21767
4	2.00000	.61492	-.09815
5	2.00000	.61492	.09815
6	2.00000	.35447	.21767
7	2.00000	.17121	.24431
8	2.00000	.05169	.25078
9	4.62108	.10432	-.50607
10	4.62108	.34550	-.49303
11	4.62108	.71936	-.43925
12	4.62107	1.24090	-.19807
13	4.62107	1.24090	.19807
14	4.62108	.71936	.43925
15	4.62108	.34550	.49303
16	4.62108	.10432	.50607
17	7.56661	.14750	-.71555
18	7.56661	.48851	-.69710
19	7.56661	1.01711	-.62107
20	7.56660	1.75450	-.28005
21	7.56660	1.75450	.28005
22	7.56661	1.01711	.62107
23	7.56661	.48851	.69710
24	7.56661	.14750	.71555
25	10.54296	.18223	-.88405
26	10.54296	.60355	-.86126
27	10.54297	1.25463	-.76732
28	10.54297	2.16767	-.34599
29	10.54297	2.16767	.34599
30	10.54297	1.25463	.76732
31	10.54296	.60355	.86126
32	10.54296	.18223	.88405
33	13.52820	.20942	-1.01596
34	13.52820	.69361	-.98977
35	13.52819	1.40413	-.88161
36	13.52818	2.40110	-.49762
37	13.52818	2.40110	.49762
38	13.52819	1.40413	.88161
39	13.52820	.69361	.98977
40	13.52820	.20942	1.01596

Figure 26.- Continued.

41	16.51560	.22419	-1.10701
42	16.51560	.75577	-1.07447
43	16.51560	1.57154	-.96083
44	16.51559	2.71429	-.43325
45	16.51559	2.71429	.43125
46	16.51560	1.57154	.96083
47	16.51560	.75577	1.07447
48	16.51560	.22419	1.10701
49	19.49647	.23177	-1.13410
50	19.49647	.77026	-1.10446
51	19.49648	1.41204	-.96434
52	19.49649	2.70473	-.44345
53	19.49649	2.70473	.44345
54	19.49648	1.41204	.96434
55	19.49647	.77026	1.10446
56	19.49647	.23177	1.13410
57	21.99291	.22750	-1.10368
58	21.99291	.75349	-1.07523
59	21.99291	1.56862	-.95795
60	21.99291	2.70620	-.43195
61	21.99291	2.70620	.43195
62	21.99291	1.56862	.95795
63	21.99291	.75349	1.07523
64	21.99291	.22750	1.10368
65	23.69567	.21860	-1.06050
66	23.69567	.72402	-1.03117
67	23.69567	1.50744	-.92047
68	23.69567	2.60029	-.41505
69	23.69567	2.60029	.41505
70	23.69567	1.50744	.92047
71	23.69567	.72402	1.03117
72	23.69567	.21860	1.06050
73	24.99668	.21104	-1.02344
74	24.99668	.69899	-.99745
75	24.99669	1.45532	-.88864
76	24.99669	2.51036	-.40070
77	24.99669	2.51036	.40070
78	24.99669	1.45532	.88864
79	24.99668	.69899	.99745
80	24.99668	.21104	1.02344

## BODY PANEL AREAS AND INCLINATION ANGLES

PANEL	AREA	DELTA RAD	THETA RAD	DELTA DEG	THETA DEG
1	.23452	.12529	-3.11870	7.17849	-178.688
2	.30865	.12773	-1.06389	7.31861	-175.548
3	.54231	.13810	-2.96162	7.91231	-169.688
4	.79094	.21266	-2.55353	12.18004	-145.166
5	.79094	.21266	-.60827	12.18004	-30.840
6	.54231	.13810	-.17494	7.91231	-10.312

Figure 26.- Continued.

7	.39865	.12773	-.07770	7.31841	-4.452
8	.23452	.12529	-.07290	7.17840	-1.312
9	.81605	.08832	-3.11870	4.60200	-178.688
10	.81603	.08190	-3.06389	4.69239	-175.548
11	1.42314	.08859	-2.96161	5.07577	-169.688
12	2.05964	.13713	-2.53351	7.85675	-145.160
13	2.05964	.13713	-.60808	7.85675	-34.840
14	1.42314	.08859	-.17998	5.07577	-10.312
15	.81063	.08190	-.07770	4.69239	-4.452
16	.61605	.08832	-.02290	4.60200	-1.312
17	.88177	.06337	-3.11869	3.63109	-178.688
18	1.16022	.06462	-3.06389	4.70252	-175.548
19	2.03642	.06991	-2.96160	4.00557	-169.687
20	2.94107	.10836	-2.53349	6.20859	-145.158
21	2.94107	.10836	-.60810	6.20859	-34.842
22	2.03642	.06991	-.17999	4.00557	-10.313
23	1.16022	.06462	-.07771	3.70252	-4.452
24	.88177	.06337	-.02290	3.63109	-1.312
25	1.09238	.05070	-3.11869	2.90465	-178.688
26	1.43729	.05169	-3.06389	2.96189	-175.548
27	2.52243	.05593	-2.96160	3.20478	-169.687
28	3.63850	.08678	-2.53350	4.97216	-145.159
29	3.63850	.08678	-.60810	4.97216	-34.841
30	2.52243	.05593	-.17999	3.20478	-10.313
31	1.43729	.05169	-.07770	2.96189	-4.452
32	1.09238	.05070	-.02290	2.90465	-1.312
33	1.25644	.03831	-3.11869	2.19495	-178.688
34	1.65312	.04906	-3.06389	2.23818	-175.548
35	2.90091	.04227	-2.96160	2.42164	-169.687
36	4.18047	.06560	-2.53349	3.75857	-145.158
37	4.18047	.06560	-.60810	3.75857	-34.842
38	2.90091	.04227	-.17999	2.42164	-10.313
39	1.65312	.03906	-.07771	2.23818	-4.452
40	1.25644	.03831	-.02290	2.19495	-1.312
41	1.56941	.02312	-3.11869	1.32458	-178.688
42	1.80171	.02357	-3.06389	1.35068	-175.548
43	3.16135	.02551	-2.96159	1.46147	-169.687
44	4.55203	.03961	-2.53347	2.26947	-145.157
45	4.55203	.03961	-.60812	2.26947	-34.843
46	3.16135	.02551	-.18000	1.46146	-10.313
47	1.80171	.02357	-.07771	1.35068	-4.452
48	1.56941	.02312	-.02290	1.32458	-1.312
49	1.40299	-.00476	-3.11869	-.27248	-178.688
50	1.84548	-.00885	-3.06389	-.27779	-175.548
51	3.25873	-.00524	-2.96160	-.30034	-169.687
52	4.66146	-.00813	-2.53348	-.46583	-145.158
53	4.66146	-.00813	-.60811	-.46583	-34.842
54	3.25873	-.00524	-.18000	-.30034	-10.313
55	1.84548	-.00485	-.07771	-.27779	-4.452
56	1.40299	-.00476	-.02290	-.27248	-1.312
57	.91036	-.02357	-3.11869	-1.35065	-178.688
58	1.19775	-.02403	-3.06389	-1.37700	-175.548

Figure 26.- Continued.



59	2.10167	-.02601	-2.96161	-1.49909	-169.687
60	3.02636	-.04040	-2.51350	-2.31449	-145.159
61	5.02636	-.04040	-.00809	-2.31449	-30.841
62	2.10167	-.02601	-.17449	-1.49909	-10.313
63	1.19775	-.02003	-.07770	-1.37700	-4.452
64	.91036	-.02357	-.02290	-1.35035	-1.312
65	.61242	-.02429	-3.11869	-1.61602	-178.688
66	.80576	-.02476	-3.06389	-1.64400	-175.508
67	1.41385	-.03113	-2.96160	-1.78371	-169.687
68	2.04629	-.04037	-2.51348	-2.77161	-145.158
69	2.03629	-.04037	-.00811	-2.77161	-14.842
70	1.41385	-.03113	-.18000	-1.78371	-10.313
71	.80576	-.02476	-.07771	-1.64400	-4.452
72	.61242	-.02429	-.02290	-1.61602	-1.312
73	.50680	-.02441	-3.11869	-1.62762	-178.688
74	.66679	-.02497	-3.06388	-1.65967	-175.508
75	1.17000	-.03134	-2.96159	-1.79569	-169.687
76	1.64508	-.04066	-2.51347	-2.78778	-145.157
77	1.64508	-.04066	-.00812	-2.78778	-14.843
78	1.17000	-.03134	-.18000	-1.79569	-10.313
79	.66679	-.02497	-.07771	-1.65967	-4.452
80	.50680	-.02441	-.02290	-1.62762	-1.312

END GEOM , TIME= .228 DT= .228

# AERODYNAMIC VELOCITY MATRIX COMPUTATION

.. VELCMP ..

PARTITION = 1

N4ING= 0 N4RDV= 80 N4CPT= 0 N4SFG= 0  
INFLUENCE OF BODY ON BODY

END BODYVEL, TIME= 5.3050 DT= 5.0770 NPART= 1  
N4RLNKE 10 N4RLNKE 1

END VELCMP, TIME= 5.3630 DT= 5.1350

BEGIN A NEW CASE

.. BODYVDV ..

END DIAGIN, TIME= 5.4350 DT= .0650

THE ITERATION CONVERGED AFTER 11 ITERATIONS WITH A TEST CRITERION OF .0010000

THE SOLUTION AT THE PREVIOUS ITERATION IS

GR(N),N=1, 80	
.60815	.60675
.70514	.73049
-.55746	-.61343
.40245	-.46254
-.56460	-.57469
-.24230	-.54706
-.35477	-.59123
-.57133	.67301
-.37538	.67160
.77418	.74809
.72887	.77488
-.59570	-.61080
-.69438	.69136
.69179	.79600

Figure 26.- Continued.

-.60161	-.60523	.69417	.49731	.49144	.78268	-.64319	-.62337	-.63162	-.63179
.70879	.70867	.69999	.79237	-.70788	-.66863	-.67059	-.66967	.72405	.70972
.70103	.80192	-.83150	-.75263	-.75308	-.75563	.80566	.79111	.76534	.76222
-.89037	-.81893	-.81511	-.81820	.73959	.74769	.85206	.90431	-.90644	-.85580
-.79820	-.79912	.82312	.80987	.78823	.81892	-.94559	-.84463	-.85797	-.86823

THE SOLUTION AT THE PRESENT ITERATION IS  
GR(4), N=1, R0

.60815	.60675	.60245	.62066	-.24230	-.35677	-.37133	-.37538	.77414	.72987
.70514	.73049	-.46254	-.54786	-.56037	-.59123	.67301	.67160	.74809	.77486
-.55746	-.61343	-.56960	-.57469	.49039	.49136	.69179	.79600	-.61080	-.39570
-.60161	-.60523	.69517	.69731	.69144	.78268	-.64319	-.62337	-.63162	-.63179
.70879	.70867	.69999	.79237	-.70788	-.66863	-.67059	-.66967	.72405	.70972
.70103	.80192	-.83150	-.75263	-.75308	-.75563	.80566	.79111	.76535	.76222
-.89037	-.81893	-.81511	-.81820	.73959	.74769	.85206	.90431	-.90644	-.85580
-.79820	-.79912	.82312	.80987	.78823	.81892	-.94559	-.84463	-.85797	-.86823

#### VORTEX LOCATION AND STRENGTH

.. ELEVAT ..

I= 1	YVRTX=	0.0000	.6530	.9900	1.2810	1.5280	1.7465	1.9320	2.1000	2.2400	2.3500
I= 1	ZVRTX=	0.0000	.2990	.5110	.7390	.9290	1.1028	1.2720	1.4230	1.5510	1.6730
I= 1	GX=	0.0000	.1910	.4725	.6750	.8510	1.0080	1.1510	1.2830	1.4060	1.5200
I= 2	YVRTX=	0.0000	-.6530	-.9900	-1.2810	-1.5280	-1.7469	-1.9320	-2.1000	-2.2400	-2.3500
I= 2	ZVRTX=	0.0000	.2990	.5110	.7390	.9290	1.1028	1.2720	1.4230	1.5510	1.6730
I= 2	GX=	0.0000	-.1910	-.4725	-.6750	-.8510	-1.0080	-1.1510	-1.2830	-1.4060	-1.5200

#### VORTEX INTERPOLATION TABLE

VORTEX		1				
STAT	XV	YVRTX	ZVRTX	RY	47	GAM/V
1	0.000	0.0000	0.0000	0.0000	0.0000	0.0000
2	2.000	.6530	.2990	.8458	.2820	.1910
3	4.000	.9900	.5110	1.3949	.4456	.4725
4	6.000	1.2810	.7390	1.8585	.6195	.6750
5	8.000	1.5280	.9290	2.2526	.7509	.8510
6	10.000	1.7465	1.1028	2.5917	.8439	1.0080
7	12.000	1.9320	1.2720	2.8866	.9072	1.1510
8	14.000	2.1000	1.4230	3.1272	1.0020	1.2830
9	16.000	2.2400	1.5510	3.3157	1.1052	1.4060
10	18.000	2.3500	1.6730	3.4399	1.1466	1.5200

Figure 26.- Continued.

VORTEX 2						
STAT	XV	YVRTX	ZVRTX	HY	AZ	GAM/V
1	0.000	0.0000	0.0000	0.0000	0.0000	0.0000
2	2.000	-.6530	.2490	.8459	.2420	-.1910
3	4.000	-.9900	.5310	1.3988	.4656	-.4725
4	6.000	-1.2810	.7390	1.8585	.6195	-.6750
5	8.000	-1.5260	.9290	2.2526	.7509	-.8510
6	10.000	-1.7465	1.1028	2.5917	.8639	-1.0080
7	12.000	-1.9320	1.2720	2.8866	.9622	-1.1510
8	14.000	-2.1000	1.4230	3.1272	1.0474	-1.2830
9	16.000	-2.2400	1.5510	3.3157	1.1152	-1.4060
10	18.000	-2.3500	1.6740	3.4396	1.1666	-1.5200

## VELOCITY ON BODY

\*\* SOLVE \*\*

MACH= 1.700 ALPHA= 10.000 PHI= 0.000

PANEL NO.	SOURCE STRENGTH	AXIAL VELOCITY	LATRAI VELOCITY	VERTICAL VELOCITY	NORMAL VELOCITY	LAT. VORTEX VELOCITY	VFD. VORTEX VELOCITY
1	.60815	-.11784	.16037E-01	-.28250	-.29530	-.21087E-03	-.15168E-04
2	.60675	-.11969	.55979E-01	-.28089	.29717	-.73365E-03	-.64852E-04
3	.60245	-.12713	.12055	-.27287	.30478	-.18811E-02	-.36981E-03
4	.62066	-.17190	.34530	-.14717	.34717	-.94219E-02	-.73666E-02
5	-.24230	-.26758E-02	-.78232E-01	.14918	.68542E-01	.13435	-.87685E-01
6	-.35677	.11105E-01	-.54029E-01	-.21314E-01	-.33651E-01	.10521	-.22110E-01
7	-.37133	.94787E-02	-.20829E-01	-.43240E-01	-.46262E-01	.23587E-01	-.23402E-02
8	-.37538	.90632E-02	-.89827E-02	-.48241E-01	-.49180E-01	.60384E-02	-.40081E-03
9	.77418	-.49925E-01	.27541E-01	-.24829	.25206	-.27852E-03	-.19886E-04
10	.72687	-.72574E-01	.82788E-01	-.24231	.25311	-.96108E-03	-.91483E-04
11	.70514	-.84087E-01	.14475	-.22865	.25730	-.24535E-02	-.48204E-03
12	.73049	-.11665	.36678	-.64115E-01	.27580	-.11940E-01	-.93151E-02
13	-.44254	.28511E-01	-.14601	.12620	-.65832E-02	.13497	-.89632E-01
14	-.54706	.23679E-01	-.99542E-01	-.64498E-01	-.83044E-01	.27169	-.57753E-01
15	-.56637	.22294E-01	-.54889E-01	-.86305E-01	-.91981E-01	.53879E-01	-.53230E-02
16	-.59123	.11527E-01	-.18945E-01	-.92995E-01	-.94028E-01	.13175E-01	-.96549E-03
17	.67301	-.70611E-01	.87470E-02	-.23148	.23562	-.30466E-03	-.21911E-04
18	.67160	-.68445E-01	.24471E-01	-.23122	.23636	-.10586E-02	-.10074E-03
19	.70809	-.41681E-01	.11979	-.21898	.23922	-.26983E-02	-.53007E-03
20	.77486	-.89709E-01	.37089	-.34114E-01	.24819	-.12995E-01	-.10132E-01
21	-.55746	.31494E-01	-.22567	.11815	-.35178E-01	.13454	-.90011E-01
22	-.61343	.11866E-01	-.91787E-01	-.86191E-01	-.10163	.35000	-.74316E-01
23	-.58960	.30961E-01	-.20133E-01	-.10615	-.10917	.69584E-01	-.69921E-02
24	-.57489	.31223E-01	-.65845E-02	-.10900	-.11088	.17166E-01	-.12591E-02
25	.69038	-.48635E-01	.10372E-01	-.22082	.22328	-.33839E-01	-.24191E-04
26	.69136	-.53028E-01	.55563E-01	-.21768	.22378	-.11885E-02	-.11119E-03
27	.69179	-.54942E-01	.10612	-.20726	.22563	-.29767E-02	-.58452E-03
28	.79800	-.59261E-01	.35246	-.26411E-01	.22734	-.14242E-01	-.11100E-01
29	-.61080	.26301E-01	-.24216	.10210	-.56628E-01	.13957	-.93826E-01
30	-.59578	.30622E-01	-.91289E-01	-.99251E-01	-.11552	.35000	-.81963E-01
31	-.60161	.26979E-01	-.48534E-01	-.11752	-.12201	.82236E-01	-.82528E-02
32	-.60523	.21438E-01	-.18269E-01	-.12221	-.12348	.20340E-01	-.14415E-02

Figure 26.- Continued.

34	.69517	-.39175E-01	.14733E-01	.20956	.21119	-.37751E-03	-.27147E-04
34	.69731	-.37754E-01	.47779E-01	.20705	.21145	-.13111E-02	-.12475E-03
35	.69166	-.43159E-01	.11499	.19321	.21240	-.33364E-02	-.65531E-03
36	.74268	-.44979E-01	.34976	-.54074E-02	.20677	-.15849E-01	-.13374E-01
37	-.64319	.30170E-01	-.26128	.89472E-01	-.77656E-01	.14440	-.10019
38	-.62337	.32803E-01	-.10279	.11120	-.12908	.35000	-.84902E-01
39	-.63162	.27081E-01	-.45964E-01	.14040	-.13453	.93442E-01	-.93865E-02
40	-.65179	.26872E-01	-.13736E-01	.14055	-.14576	.23403E-01	-.17147E-02
41	.70879	-.20666E-01	.12106E-01	.19567	.19632	-.43398E-01	-.31208E-04
42	.70667	-.23565E-01	.50166E-01	.19247	.19629	-.15471E-02	-.14339E-03
43	.69999	-.28498E-01	.10973	-.17848	.19590	-.38431E-02	-.75282E-03
44	.79237	-.19270E-01	.34012	.22758E-01	.18140	-.18192E-01	-.14168E-01
45	-.70788	.29386E-01	-.29248	.74930E-01	-.10341	.16169	-.11091
46	-.66863	.34123E-01	-.99607E-01	.12910	-.14567	.35000	-.84639E-01
47	-.67059	.38967E-01	-.47305E-01	.14594	-.14986	.10323	-.10276E-01
48	-.66967	.31067E-01	-.14531E-01	.14982	-.15079	.26073E-01	-.19075E-02
49	.72405	.10358E-01	.17563E-01	.16851	.16892	0.	0.
50	.70972	.18017E-03	.58409E-01	-.16429	.16835	0.	0.
51	.70104	-.27017E-02	.10653	.14903	.16568	0.	0.
52	.80192	.36156E-01	.35251	.81845E-01	.13451	0.	0.
53	-.83150	.24908E-01	-.34667	.57674E-01	-.15052	0.	0.
54	-.75263	.44304E-01	-.10389	-.16023	0.	0.	0.
55	-.75308	.40954E-01	-.54426E-01	-.17440	-.17790	0.	0.
56	-.75563	.39542E-01	-.15980E-01	-.17415	-.17828	0.	0.
57	.80566	.32240E-01	.35015E-01	-.14887	.15035	0.	0.
58	.79111	.34623E-01	.80856E-01	-.14277	.14941	0.	0.
59	.76535	.28214E-01	.12924	-.12355	.14518	0.	0.
60	.76222	.54103E-01	.31738	.98433E-01	.10263	0.	0.
61	-.89037	.23917E-01	-.37223	.35782E-01	-.18217	0.	0.
62	-.81893	.34415E-01	-.12483	-.17788	-.19649	0.	0.
63	-.81511	.37500E-01	-.54130E-01	-.19407	-.19674	0.	0.
64	-.81820	.42946E-01	-.21014E-01	-.19734	-.19676	0.	0.
65	.75959	.43137E-01	.13606E-01	-.14433	.14576	0.	0.
66	.74769	.38085E-01	.31969E-01	-.14164	.14473	0.	0.
67	.85206	.56250E-01	.17220	-.10936	.14011	0.	0.
68	.80431	.42408E-01	.33927	.12314	.94731E-01	0.	0.
69	-.96644	.27204E-02	-.39092	.40223E-01	-.18997	0.	0.
70	-.85540	.21245E-01	-.13724	-.18051	-.20141	0.	0.
71	-.79820	.32517E-01	-.51720E-01	-.19498	-.20137	0.	0.
72	-.79912	.24432E-01	-.17669E-01	-.20172	-.20131	0.	0.
73	.82312	.37525E-01	.20165E-01	-.14413	.14556	0.	0.
74	.80987	.52047E-01	.57851E-01	-.13901	.14453	0.	0.
75	.78423	.74790E-01	.11422	-.11910	.13990	0.	0.
76	.81892	.41946E-01	.35553	.14077	.94450E-01	0.	0.
77	-.94549	-.57881E-02	-.41097	.54450E-01	-.19025	0.	0.
78	-.84463	-.41409E-02	-.12342	-.18244	-.20162	0.	0.
79	-.85797	.15042E-01	-.45474E-01	-.19913	-.20157	0.	0.
80	-.86823	.22596E-01	-.80174E-02	-.20210	-.20150	0.	0.

Figure 26.- Continued.

LRC 3/1 ELLIPTIC WING/BODY MISSILE CONFIGURATION - NOSE VORTICITY  
 ELLIPTIC BODY PANELING - KRAO=0, KFOR=11

INTEGRATION OF THE PRESSURE DISTRIBUTION

•• FORMUM ••

ON THE BODY

MACH = 1.7000 ALPHAC= 10.0000 PWTB= 0.0000

POINT	X	Y	Z	THETP	CP	CX	CY	CZ	CW	CLN	CLL
1	2.00000	.05169	-.25078	281.64720	.27940	.00819	-.00149	.06499	.95986	-.02161	-.00209
2	2.00000	.17121	-.24431	305.02186	.28070	.01104	-.00667	.08567	1.26526	-.09683	-.01304
3	2.00000	.35047	-.21767	328.59115	.28509	.02128	-.02741	.15066	2.22517	-.39812	-.04774
4	2.00000	.61492	-.09815	350.93129	.26536	.04430	-.11720	.16838	2.48774	-1.70736	-.09204
5	2.00000	.61492	.09815	9.06871	-.01818	-.00303	.00803	.01154	.17044	.11647	-.00631
6	2.00000	.35047	.21767	31.40884	-.01042	-.00078	.00100	.00551	.08131	.01455	-.00174
7	2.00000	.17121	.24431	54.97814	-.00503	-.00020	.00012	.00153	.02246	.00173	-.00023
8	2.00000	.05169	.25078	78.35280	-.00324	-.00010	.00002	.00076	.01126	.00025	-.00004
9	4.62108	.10432	-.50607	281.64720	.13039	.00644	-.00183	.08004	.97159	-.02165	-.00742
10	4.62108	.34550	-.49303	305.02186	.17489	.01160	-.01097	.14087	1.70990	-.12457	-.04326
11	4.62108	.71936	-.43925	328.59112	.18609	.02343	-.04722	.25954	3.15059	-.55827	-.16596
12	4.62107	1.24090	-.19807	350.93124	.11943	.03362	-.11921	.19999	2.42901	-1.65365	-.22060
13	4.62107	1.24090	.19807	9.06877	-.06978	.01965	.08133	.11685	1.40197	.96617	-.12889
14	4.62108	.71936	.43925	31.40884	-.04759	-.00599	.01208	.06637	.80571	.14277	-.04204
15	4.62108	.34550	.49303	54.97815	-.02068	-.00137	.00130	.01666	.29218	.01532	-.00512
16	4.62108	.10432	.50607	78.35281	.00093	.00005	-.00001	.00057	-.00697	-.00016	.00005
17	7.56661	.14750	-.71555	281.64719	.18039	.01007	-.00363	.15870	1.45815	-.03207	-.02081
18	7.56661	.48851	-.69710	305.02184	.17489	.01310	-.01572	.20187	1.85085	-.13873	-.08786
19	7.56661	1.01711	-.62107	328.59108	.10136	.01442	-.03686	.20257	1.86108	-.32568	-.18315
20	7.56660	1.75450	-.28005	350.93114	.05410	.01784	-.09371	.13462	1.23799	-.83393	-.20995
21	7.56660	1.75450	.28005	9.06886	-.07716	-.02454	.12889	.18516	1.70274	1.14700	-.28876
22	7.56661	1.01711	.62107	31.40893	-.05810	-.00826	.02113	.11612	1.06707	.18669	-.10499
23	7.56661	.48851	.69710	54.97816	-.03687	-.00276	.00331	.04256	.39101	.02925	-.01848
24	7.56661	.14750	.71555	78.35281	-.03550	-.00198	.00072	.03123	.28695	.00631	-.00409
25	10.54296	.18223	-.88405	281.64719	.12751	.00706	-.00319	.13908	.86397	-.01864	-.02253
26	10.54296	.60355	-.86126	305.02185	.13894	.01032	-.01548	.19803	1.23519	-.09064	-.10667
27	10.54297	1.25663	-.76732	328.59109	.13496	.01903	-.06085	.33441	2.07784	-.35682	-.37354
28	10.54297	2.16767	-.34599	350.93117	.01052	.00332	-.02178	.03128	.19459	-.12906	-.06028
29	10.54297	2.16767	.34599	9.06883	-.06288	-.01983	.13021	.18708	1.16358	.77175	-.36043
30	10.54297	1.25663	.76732	31.40892	-.09134	-.01288	.06118	.22632	1.40621	.24148	-.25280
31	10.54296	.60355	.86126	54.97816	-.02675	-.00199	.00298	.03827	.23777	.01745	-.02053
32	10.54296	.18223	.88405	78.35281	-.01888	-.00082	.00037	.01623	.10081	.00218	-.00263
33	13.52820	.20402	-1.01596	281.64719	.11238	.00541	-.00323	.14105	.45601	-.00944	-.02626
34	13.52820	.69361	-.99977	305.02184	.10721	.00692	-.01375	.17656	.57083	-.04618	-.10886
35	13.52819	1.44413	-.88181	328.59108	.10771	.01370	-.05588	.30712	.99320	-.16378	-.39624
36	13.52818	2.49110	-.39782	350.93115	-.01878	.00515	-.04476	.06430	-.20834	.13363	-.14210
37	13.52818	2.49110	.39782	9.06883	-.06605	-.01810	.15741	.22614	.73269	.06994	-.50075
38	13.52819	1.44413	.88181	31.40893	-.09052	-.01110	.06097	.25812	.83473	.13765	-.35134
39	13.52820	.69361	.99977	54.97816	-.02682	-.00173	.00344	.04417	.14281	.01005	-.02723
40	13.52820	.20402	1.01596	78.35281	-.02454	-.00118	.00071	.03080	.09947	.00206	-.00573
41	16.51560	.22819	-1.10701	281.64719	.07340	.00232	-.00030	.10046	.02602	-.00012	-.02038
42	16.51560	.75477	-1.07847	305.02183	.07725	.00328	-.01080	.13872	.03591	-.00059	-.09319

Figure 26.- Continued.

43	1A,51560	1,57354	-.96043	32A,59103	.07A29	.00611	-.04430	.24343	.06317	-.00267	-.34049
44	1A,51559	2,71429	-.43325	350,93104	-.07101	-.01240	.1A453	-.2650A	-.0A945	.01774	.65956
45	1A,51559	2,71429	.43325	9,0A896	-.04223	-.01122	.16171	.23230	.06121	.01554	-.50046
46	1A,51560	1,57354	.9A043	31,40A97	-.09515	-.00767	.05344	.295A6	.07677	.00324	-.413A1
47	1A,51560	.75577	1,07A47	54,97617	-.03444	-.00146	.00480	.06167	.01597	.00026	-.00143
48	1A,51560	.22819	1,10701	7A,352A1	-.031A5	-.00101	.00100	.04360	.0112A	.00005	-.008A4
49	19,496A7	.25377	-1,13410	2A1,64719	.00937	-.00006	-.00030	.01315	-.0355A	.00000	-.00273
50	19,496A7	.77426	-1,10A86	305,02184	.02A7A	-.00024	-.00384	.0492A	-.13264	.01016	-.03302
51	19,496A8	1,41204	-.9A434	32A,5910A	.02392	-.00041	-.013A7	.07621	-.20512	.03674	-.10920
52	19,496A9	2,7A071	-.403A5	350,93110	-.19561	.00741	.52092	-.74A34	2,01449	-1,3A027	1,84971
53	19,496A9	2,7A073	.403A5	9,0A890	-.1A75A	.00635	.44627	.64110	-1,72615	-1,1A589	-1,5A443
54	19,496A6	1,61204	.0A434	31,40A95	-.06657	.00113	.03860	.21212	-.57094	-.10227	-.30195
55	19,496A7	.7742A	1,10A86	54,97A1A	-.05299	.00047	.00759	.09751	-.26246	-.02011	-.06711
56	19,496A7	.25377	1,13410	7A,352A1	-.007A2	.00032	.00154	.06707	-.18052	-.00407	-.01394
57	21,09291	.22750	-1,1036A	2A1,64720	-.03529	.0007A	.00074	-.03211	.1A559	-.00365	.00049
58	21,09291	.75349	-1,07523	305,021A5	-.04517	.00130	.00420	-.05393	.27864	-.02082	.03612
59	21,09291	1,56A82	-.95795	32A,59110	-.04397	.00240	.01654	-.090A9	.04949	-.08211	.12675
60	21,09291	2,70620	-.43195	350,93110	-.210A1	.02576	.36418	-.52319	2,70533	-1,82143	1,25854
61	21,09291	2,70620	.43195	9,0A8A1	-.17270	.02111	.29816	.42A62	-2,21668	-1,49222	-1,03107
62	21,09291	1,56A82	.95795	31,40A91	-.05231	.00286	.01947	.10A13	-.55A75	-.0976A	-.1507A
63	21,09291	.75349	1,07523	54,97615	-.046A1	.00135	.00435	-.055A8	-.2A8A7	-.0215A	-.03743
64	21,09291	.22750	1,1036A	7A,352A1	-.05325	.00114	.00111	.04A45	-.25033	-.00550	-.009A0
65	23,695A7	.21A60	-1,06050	2A1,64719	-.05535	.00096	.00078	-.033A7	.23257	-.00514	.00658
66	23,695A7	.72402	-1,03317	305,02184	-.04A69	.00108	.00292	-.03749	.25741	-.01935	.02413
67	23,695A7	1,50744	-.92047	32A,59105	-.10794	.00475	.02731	-.15007	1,03043	-.1A114	.20108
68	23,695A7	2,60029	-.41505	350,93110	-.21421	.02109	.24892	-.3575A	2,45762	-1,66161	.82651
69	23,695A7	2,60029	.41505	9,0A890	-.15303	.01507	.177A3	.25546	-1,75529	-1,1A705	-.59045
70	23,695A7	1,50744	.92047	31,40A94	-.03043	.00134	.00770	.04231	-.29009	-.05107	-.05649
71	23,695A7	.72402	1,03317	54,97817	-.03722	.00086	.00233	.02989	-.20520	-.01542	-.01923
72	23,695A7	.21A60	1,06050	7A,352A1	-.01939	.00033	.00027	.01187	-.08147	-.00180	-.00231
73	24,996A8	.21104	-1,023A4	2A1,64719	-.04490	.00065	.00052	-.02274	.1A575	-.00413	.00427
74	24,996A8	.69A99	-.99745	305,021A4	-.07521	.00145	.00389	-.0499A	.40A21	-.03088	.031A5
75	24,996A9	1,45532	-.8A864	32A,59103	-.12541	.00460	.02626	-.1442A	1,17A57	-.20A52	.1A665
76	24,996A9	2,51036	-.40070	350,93104	-.2251A	.01A45	.21651	-.31103	2,54109	-1,72A3A	.69403
77	24,996A9	2,5103A	.40070	9,06A96	-.15733	.01289	.15129	.21733	-1,77623	-1,20771	-.48496
78	24,996A9	1,45532	.8A864	31,40A97	.02147	-.00086	-.00489	-.0268A	.21959	.03A85	.03478
79	24,996A8	.69A99	.99745	54,97A17	-.00245	.00005	.00013	-.00163	-.01329	-.00101	-.00101
80	24,996A8	.21104	1,023A4	7A,352A1	-.01555	.00022	.00018	.00787	-.0A431	-.00143	-.00148

TOTAL COEFFICIENTS  
-----  
ON THE BODY

DEFA#	12,567A	WFF0#	3,4641	REFL#	1,0000
XM #	16,4000	ZM #	0,0000		
YACHE	1,70000				
ALPHA#	10,00000	ALPHA#	10,00000		
PMIR#	0,00000	META#	0,00000		
CX#	.04322				

Figure 26.- Continued.

CY= 0.00000  
 CZ= .85386  
 CM= 1.94833  
 CLN= 0.00000  
 CLL= 0.00000  
 XCP= 8.89360

FOLLOWING ARE IN WIND AXIS SYSTEM

CL= .85386  
 CY= 0.00000  
 CZ= .19083  
 CM= 1.94833  
 CNY44= 0.00000

LRC 3/1 ELLIPTIC WING/HODY MISSILE CONFIGURATION - NOISE VORTICITY  
 ELLIPTIC HODY PANELING - KHA0=9, KAPRY=11

INTEGRATION OF THE PRESSURE DISTRIBUTION

\*\* FORMOM \*\*

ON THE HODY FROM XSTART= 0.0000 TO XELE= 18.0000

MACH = 1.7000 ALPHAC= 10.0000 PHIR= 0.0000

POINT	X	Y	Z	THETP	CP	CX	CY	CZ	CM	CLN	CLL
1	2.00000	.05169	-.25078	281.64720	.27940	.00819	-.00149	.06499	.95946	-.02161	-.00299
2	2.00000	.17121	-.20431	305.02186	.28070	.01104	-.00667	.08567	1.26526	-.09683	-.01304
3	2.00000	.35447	-.21767	328.59115	.28509	.02128	-.02741	.15066	2.22517	-.34812	-.04774
4	2.00000	.61492	-.09815	350.93129	.26536	.04430	-.11720	.16838	2.49774	-1.70736	-.09204
5	2.00000	.61492	.00815	9.06871	-.01818	-.00303	.00803	.01154	.17044	.11497	-.00631
6	2.00000	.35447	.21767	31.40886	-.01042	-.00078	.00100	.00551	.08131	.01455	-.00174
7	2.00000	.17121	.24431	54.97814	-.00503	-.00020	.00012	.00153	.02246	.00173	-.00023
8	2.00000	.05169	.25078	78.35286	-.00328	-.00010	.00002	.00076	.01126	.00025	-.00074
9	4.62108	.10432	-.50607	281.64720	.13039	.00644	-.00183	.08004	.97159	-.02105	-.00747
10	4.62108	.34550	-.49303	305.02186	.17489	.01160	-.01097	.14087	1.70990	-.12957	-.04326
11	4.62108	.71936	-.43925	328.59115	.18609	.02343	-.04722	.25954	3.15059	-.55827	-.16596
12	4.62107	1.24090	-.19807	350.93123	.11943	.03362	-.13921	.19999	2.42901	-1.45365	-.22060
13	4.62107	1.24090	.19807	9.06877	-.06978	-.01965	.08133	.11685	1.41917	.06417	-.12889
14	4.62108	.71936	.43925	31.40886	-.04759	-.00599	.01208	.06637	.80571	.14277	-.04244
15	4.62108	.34550	.49303	54.97815	-.02068	-.00137	.00130	.01666	.20218	.01532	-.00512
16	4.62108	.10432	.50607	78.35281	.00093	.00005	-.00001	-.00057	-.00697	-.00016	-.00005
17	7.56661	.14750	-.71555	281.64719	.18039	.01007	-.00363	.15870	1.45815	-.03207	-.02081
18	7.56661	.48451	-.69710	305.02184	.17489	.01310	-.01572	.20187	1.85485	-.13873	-.08746
19	7.56661	1.01711	-.62107	328.59108	.10136	.01442	-.03686	.20257	1.86148	-.32588	-.18315
20	7.56660	1.75450	-.28005	350.93119	.05610	.01784	-.09371	.13462	1.23799	-.23393	-.20995
21	7.56660	1.75450	.28005	9.06886	-.07716	-.02454	.12889	.18516	1.70274	1.14700	-.28876
22	7.56661	1.01711	.62107	31.40893	-.05810	-.00826	.02113	.11612	1.06707	.18669	-.10499
23	7.56661	.48451	.69710	54.97816	-.03687	-.00276	.00331	.04256	.39101	.02925	-.01848
24	7.56661	.14750	.71555	78.35281	-.03450	-.00198	.00072	.03123	.28695	.00631	-.00409
25	10.54296	.18223	-.88405	281.64719	.12751	.00706	-.00319	.13908	.88397	-.01864	-.02253

Figure 26.- Continued.

26	10.54296	.60355	-.86126	305.02185	.13894	.01032	-.01548	.19883	1.23519	-.09064	-.10667
27	10.54297	1.25563	-.76732	328.59100	.13406	.01903	-.06085	.33441	2.07780	-.35682	-.37354
28	10.54297	2.16767	-.40599	350.93117	.01052	.00332	-.02178	.03128	.19459	-.12906	-.06028
29	10.54297	2.16767	.34599	9.06883	-.06288	-.01983	.13021	.18706	1.16358	.77175	-.36043
30	10.54297	1.25563	.76732	31.40892	-.00134	-.01288	.04118	.22632	1.40621	.24148	-.25280
31	10.54296	.60355	.86126	54.97816	-.02675	-.00199	.00298	.03827	.23777	.01745	-.02053
32	10.54296	.18223	.88405	78.35281	-.01488	-.00082	.00037	.01623	.10081	.00218	-.00263
33	13.52820	.20942	-1.01596	281.64719	.11238	.00541	-.00323	.14105	.45601	-.00944	-.02426
34	13.52820	.69361	-.98977	305.02184	.10721	.00692	-.01375	.17656	.57086	-.04018	-.10886
35	13.52819	1.40413	-.86181	328.59100	.10771	.01320	-.05568	.30712	.99320	-.16378	-.39424
36	13.52818	2.40110	-.39762	350.93115	-.01878	-.00515	.04476	-.06430	-.20834	.13363	.14239
37	13.52818	2.40110	.39762	9.06886	-.06605	-.01810	.15741	.22614	.73269	.06994	-.50075
38	13.52819	1.40413	.86181	31.40893	-.09052	-.01110	.04697	.25812	.83473	.11765	-.33134
39	13.52820	.69361	.98977	54.97816	-.02682	-.00173	.00344	.04417	.14281	.01045	-.02723
40	13.52820	.20942	1.01596	78.35281	-.02454	-.00118	.00071	.03080	.09957	.00206	-.00573
41	16.51560	.22819	-1.10701	281.64719	.07340	.00232	-.00230	.10046	.02600	-.00012	-.02018
42	16.51560	.75577	-1.07847	305.02183	.07725	.00328	-.01080	.13872	.04591	-.00059	-.09319
43	16.51560	1.57354	-.96083	328.59103	.07829	.00631	-.04430	.24343	.06317	-.00267	-.34049
44	16.51559	2.71429	-.43325	350.93104	-.07101	-.01280	.19453	-.26508	-.06985	.01774	.63956
45	16.51559	2.71429	.43325	9.06896	-.06223	-.01122	.16171	.23230	.06121	.01550	-.56046
46	16.51560	1.57354	.96083	31.40897	-.00915	-.00767	.05384	.29586	.07677	.00324	-.41381
47	16.51560	.75577	1.07847	54.97817	-.03434	-.00146	.00480	.06167	.01597	.00024	-.04143
48	16.51560	.22819	1.10701	78.35281	-.03185	-.00101	.00140	.04360	.01128	.00005	-.00884

# TOTAL COEFFICIENTS

ON THE BODY FROM XSTART = 0.0000 TO XWLF = 18.0000

REFR =	12.5670	REFD =	1.4641	REFL =	1.0000
XM =	16.8000	ZM =	0.0000		
PACH =	1.70000				
ALPHAC =	10.00000	ALPHA =	10.00000		
PHIR =	0.00000	PETA =	0.00000		
CX =	.01841				
CY =	0.00000				
CZ =	.88865				
C4 =	1.78654				
CLN =	0.00000				
CLL =	0.00000				
XCP =	9.83546				

# FOLLOWING ARE IN MAIN AXIS SYSTEM

CL =	.87190
CY =	0.00000
CD =	.17264
CW =	1.78654
CNYAW =	0.00000

CPSTAR = 1.94542 CPCRIT = .79466 CPVAC = -.49031

END SOLVE, TIME = 6.4530 DT = 1.0000



## PERTURBATION VELOCITIES AT SPECIFIED CONTROL POINTS BY SOURCE PANELS

\*\* BODYVEL \*\*

CONTROL POINT				PANEL ANGLES		VELOCITIES			
JCPT	X	Y	Z	THET	DELTA	U	V	W	NORMAL
1	21.9A180	3.64130	0.00000	0.00000	.12529	.03077	-.03893	.27791	.2718A
2	25.47690	3.64130	0.00000	0.00000	.12773	.01671	-.03515	.20167	.19790
3	22.79380	4.00490	0.00000	0.00000	.13A10	.02A26	-.0335A	.1728A	.16732
4	25.715A0	4.00490	0.00000	0.00000	.21266	.01619	-.02840	.14465	.13797
5	21.40470	4.36790	0.00000	0.00000	.21266	.02664	-.03160	.12540	.11695
6	25.95190	4.36790	0.00000	0.00000	.13A10	.01549	-.0241A	.11243	.10923
7	21.5A590	2.81A00	.44979	0.00000	.12773	.02376	-.15273	.05990	.05630
8	21.5A590	1.63360	.99752	0.00000	.12529	.01627	-.12796	-.17431	-.17747
9	21.5A590	.78462	1.11960	0.00000	.08032	.03568	-.05563	-.18569	-.18796
10	21.5A590	.23690	1.14930	0.00000	.08190	.04522	-.01440	-.1951A	-.19A23
11	21.5A590	.23690	-1.14930	0.00000	.08459	.01995	.02000	-.1536A	-.15480
12	21.5A590	.78462	-1.11960	0.00000	.13713	.04230	.08505	-.1277A	-.13234
13	21.5A590	1.63360	-.44979	0.00000	.13713	.02622	.11A54	-.12042	-.1228A
14	21.5A590	2.81A00	-.44979	0.00000	.08459	.05307	.10334	.12184	.1166A
15	25.36050	2.81A00	.44979	0.00000	.08190	-.00575	-.13634	.14262	.14262
16	25.36050	1.63360	.99752	0.00000	.08032	.00208	-.13981	-.18074	-.18033
17	25.36050	.78462	1.11960	0.00000	.06337	.00767	-.0635A	-.1438A	-.14397
18	25.36050	.23690	1.14930	0.00000	.08462	.02787	-.01179	-.20495	-.20632
19	25.36050	.23690	-1.14930	0.00000	.06991	.03946	.01976	-.13909	-.14150
20	25.36050	.78462	-1.11960	0.00000	.10A36	.05313	.06791	-.13473	-.1396A
21	25.36050	1.63360	-.44979	0.00000	.10A36	.05702	.1270A	-.11184	-.11735
22	25.36050	2.81A00	-.44979	0.00000	.06991	.04292	.27085	.21186	.20835

Figure 26.- Concluded.

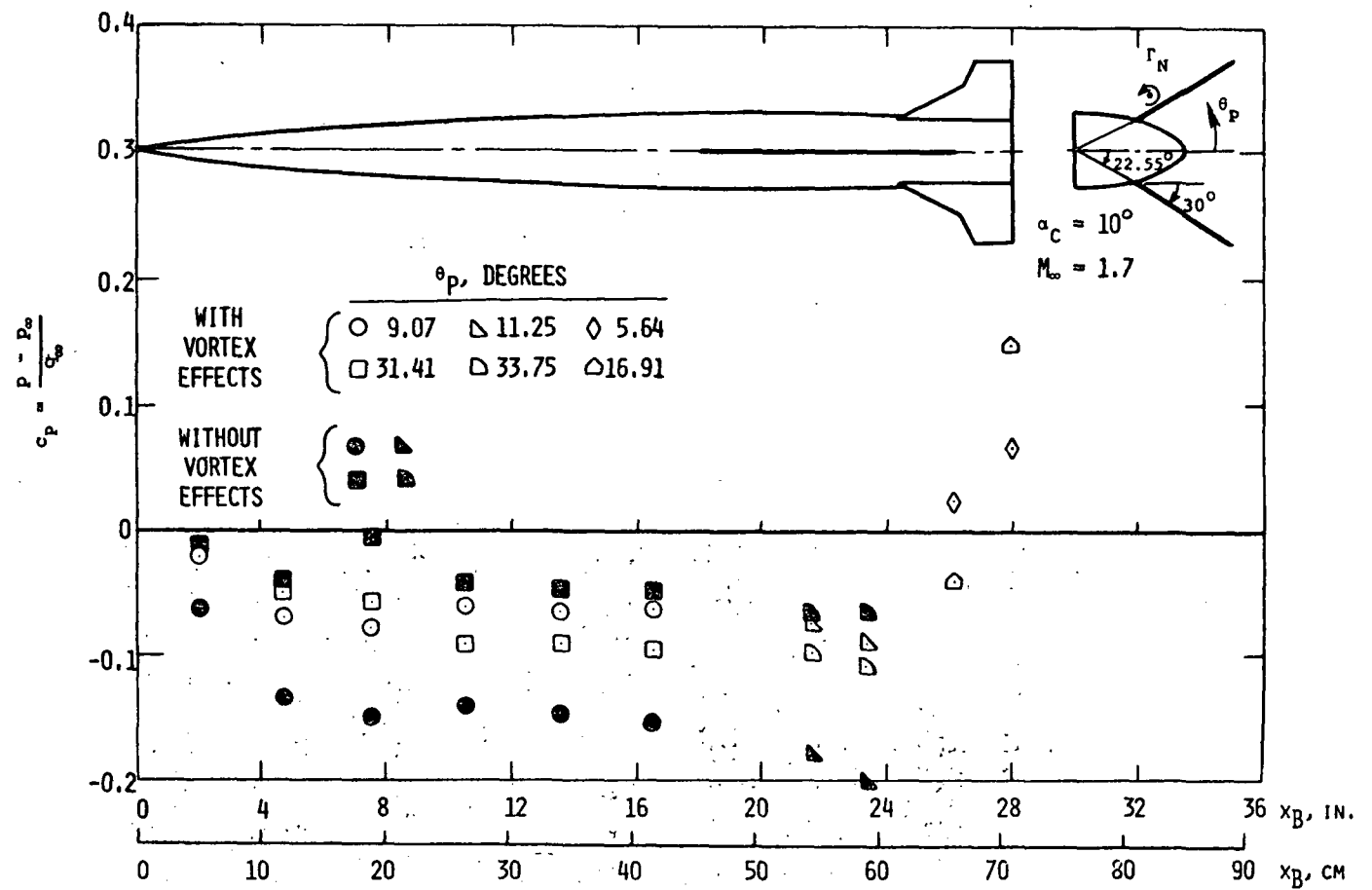


Figure 27(a).- Calculated pressure distributions, second sample case.

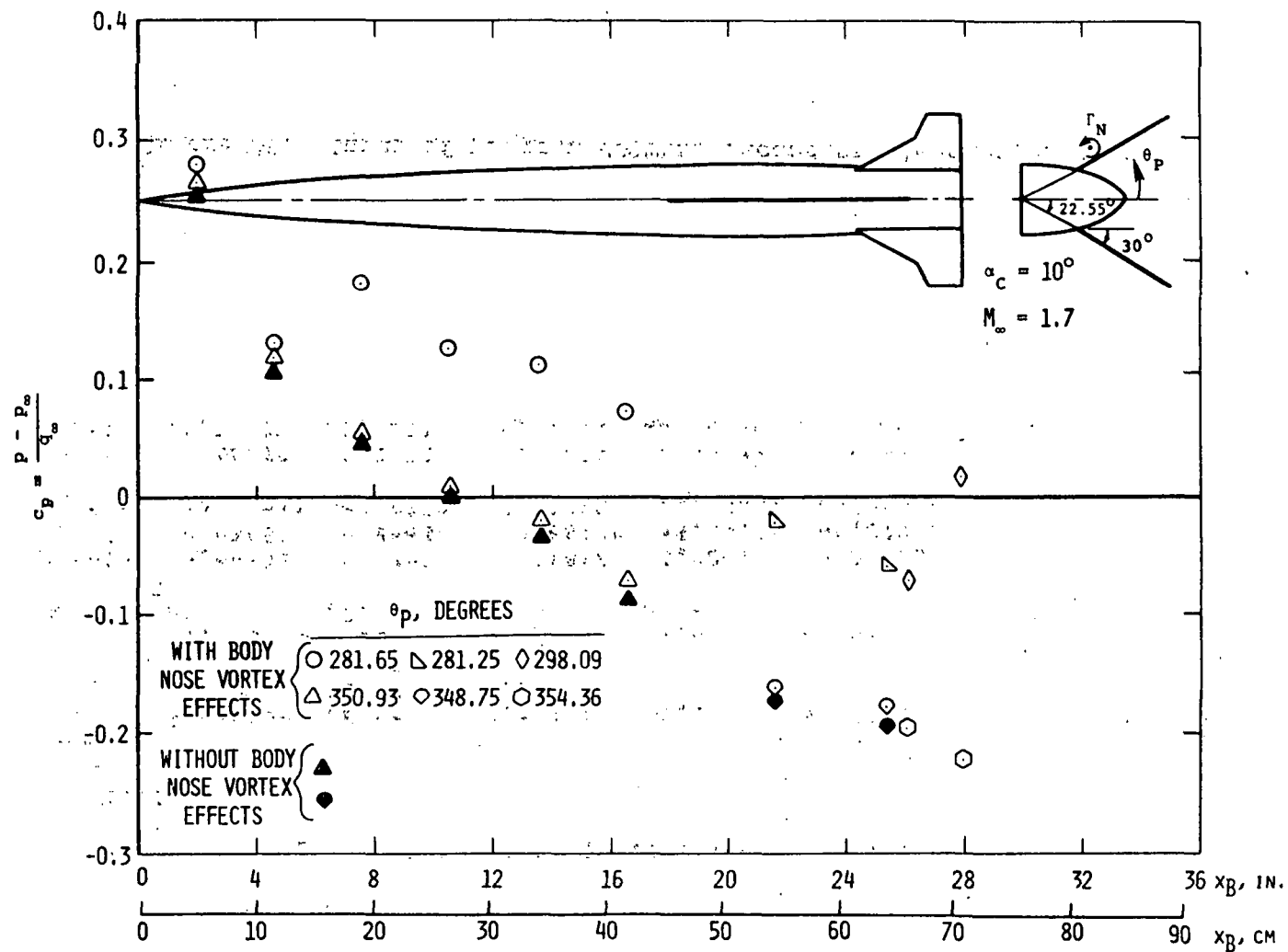


Figure 27(b).- Concluded.

LRC 3/1 ELLIPTICAL BODY/MONOPLANE WING, TRACK BODY NOSE VORTICES.

	1	4	5	1	1	0	0
0.3333333							
25.55							
3.464106							
18.0	3.464106	22.081	4.55761	25.55	4.55761	25.56	3.464106
10.0	0.0	0.0001	0.50				
2	2	2	2				
2.35	1.673	1.52	-2.35	1.673	-1.52		
18.0	20.0	22.0	24.0	25.55			
	3	3					
0.66148	3.64135	0.27984	2.01812	3.82511	0.27786		
3.37295	4.03457	0.28634	0.66148	-3.64135	-0.27984		
2.01812	-3.82511	-0.27786	3.37295	-4.03457	-0.28634		
	2						
4.081	4.34073	0.44937	6.13099	4.40075	0.58150		
4.081	-4.34073	-0.44937	6.13099	-4.40075	-0.58150		

Figure 28.- Input of program VPATHL, second sample case, step 4.

LRC 3/1 ELLIPTICAL BODY/MONOPLANE WING, TRACK BODY NOSE VORTICES.

FIN GEOMETRY

FIN SEMISPAN	=	4.55761
FIN ROOTCHORD	=	7.56000
FIN ROOT L.E. X-STATION	=	18.00000
L.E. Y-STATION	=	3.46411
FIN TIP L.E. X-STATION	=	22.08100
L.E. Y-STATION	=	4.55761
FIN TIP T.E. X-STATION	=	25.55000
T.E. Y-STATION	=	4.55761
FIN ROOT T.E. X-STATION	=	25.56000
T.E. Y-STATION	=	3.46411

INCLUDED ANGLE OF ATTACK(DEG) = 10.00000 WING ANGLE(DEG) = 0.00000

FIN LEADING EDGE VORTICITY

JLF	X	Y OR Z	HAR	GAMMA/VINF.
1	18.66148	3.64135		.27984
2	20.01812	3.82511		.27786
3	21.47295	4.03457		.28634
4	18.66148	-3.64135		-.27984
5	20.01812	-3.82511		-.27786
6	21.47295	-4.03457		-.28634

FIN SIDE EDGE VORTICITY

JSE	X	Y OR Z	HAR	GAMMA/VINF.
1	22.08100	4.34073		.44937
2	24.13099	4.40075		.58150
3	22.08100	-4.34073		-.44937
4	24.13099	-4.40075		-.58150

\*\*\*\*PERMISSIBLE RELATIVE ERROR,ES,USED IN INTEGRATION SCHEME = .10000E+03

VORTEX COORDINATES IN CROSS-FLUID PLANE

Figure 29.- Output of program VPATHL, second sample case, step 4.

INITIAL VORTEX POSITIONS AT X = 18.000

LOCAL BODY HORIZONTAL SEMI-AXIS = 3.46411  
 LOCAL BODY VERTICAL SEMI-AXIS = 1.15470  
 LOCAL SEMI SPAN S = 3.46411

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	.21500E+01	.16730E+01	.15200E+01
2	-.23500E+01	.16730E+01	-.15200E+01

X-STATION NO. 2 X=20.000 INTEGRATION STEP SIZE = 1.00000

LOCAL BODY HORIZONTAL SEMI-AXIS = 3.46411  
 LOCAL BODY VERTICAL SEMI-AXIS = 1.15470  
 LOCAL SEMI SPAN S = 4.00000

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	.23864E+01	.17470E+01	.15200E+01
2	-.23864E+01	.17470E+01	-.15200E+01

X-STATION NO. 3 X=22.000 INTEGRATION STEP SIZE = 1.00000

LOCAL BODY HORIZONTAL SEMI-AXIS = 3.46411  
 LOCAL BODY VERTICAL SEMI-AXIS = 1.15470  
 LOCAL SEMI SPAN S = 4.53591

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	.24152E+01	.18080E+01	.15200E+01
2	-.24152E+01	.18080E+01	-.15200E+01

X-STATION NO. 4 X=24.000 INTEGRATION STEP SIZE = 1.00000

LOCAL BODY HORIZONTAL SEMI-AXIS = 3.46411  
 LOCAL BODY VERTICAL SEMI-AXIS = 1.15470  
 LOCAL SEMI SPAN S = 4.55761

VORTEX	Y,VRTX	Z,VRTX	GAMMA/VINF
1	.24432E+01	.18508E+01	.15200E+01
2	-.24432E+01	.18508E+01	-.15200E+01

X-STATION NO. 5 X=25.550 INTEGRATION STEP SIZE = 1.00000

LOCAL BODY HORIZONTAL SEMI-AXIS = 5.44011  
 LOCAL BODY VERTICAL SEMI-AXIS = 1.15470  
 LOCAL SEMI SPAN S = 4.55761

VORTEX	Y, VRTX	Z, VRTX	GAMMA/VIRF
1	.24609E+01	.18792E+01	.15260E+01
2	-.24609E+01	.18792E+01	-.15260E+01

## CROSSFLOW VELOCITIES AT CONTROL POINTS INDUCED BY VORTICES AND THEIR IMAGES

IC	X, BODY	Y, BODY	Z, BODY	V	W
1	.21982E+02	.36413E+01	0.	.22027E-01	-.73043E-01
2	.25477E+02	.36413E+01	0.	.25261E-01	-.78140E-01
3	.22794E+02	.40049E+01	0.	.32848E-01	-.58780E-01
4	.25716E+02	.40049E+01	0.	.30452E-01	-.41193E-01
5	.23605E+02	.45679E+01	0.	.32109E-01	-.21043E-01
6	.25954E+02	.45679E+01	0.	.33399E-01	-.22172E-01
7	.21586E+02	.31558E+01	.50368E+00	.18131E+00	-.12379E+00
8	.21586E+02	.16764E+01	.10237E+01	.38057E+00	-.75801E-01
9	.21586E+02	.79548E+00	.11457E+01	.11080E+00	-.10914E-01
10	.21586E+02	.23983E+00	.11635E+01	.28788E-01	-.20990E-02
11	.21586E+02	.21983E+00	-.11635E+01	-.52670E-03	-.57474E-04
12	.21586E+02	.79548E+00	-.11457E+01	-.18247E-02	-.17398E-03
13	.21586E+02	.16764E+01	-.10237E+01	-.46457E-02	-.91279E-03
14	.21586E+02	.31558E+01	-.50368E+00	-.21879E-01	-.17031E-01
15	.25361E+02	.31558E+01	.50368E+00	.18892E+00	-.12949E+00
16	.25361E+02	.16764E+01	.10237E+01	.35303E+00	-.69873E-01
17	.25361E+02	.79548E+00	.11357E+01	.11003E+00	-.10781E-01
18	.25361E+02	.23983E+00	.11635E+01	.29018E-01	-.21119E-02
19	.25361E+02	.21983E+00	-.11635E+01	-.57450E-03	-.41311E-04
20	.25361E+02	.79548E+00	-.11357E+01	-.19944E-02	-.18974E-03
21	.25361E+02	.16764E+01	-.10237E+01	-.50641E-02	-.99439E-03
22	.25361E+02	.31558E+01	-.50368E+00	-.23762E-01	-.18491E-01

Figure 29.- Concluded.

```

IDEALIZED LRC ELLIPTICAL BODY MONOPLANE WING
$INPUT
CRP=7.54926, SWLEP=75.0, SWTEP=30.01584, B2=1.0935, HIL=7.54926,
XWLE=18.0,
RB=3.464106, RA=1.1547005, ERATIO=3.0,
NCW=2, MSWP=3, MSWL=0, NBDGR=8, NCWB=2,
NRDGR=16,
ALFAC=10.0, PHI=0.0, FMACH=1.7,
SREF=12.567, REFL=3.464106,
NDLINP=1, NDRAG=1, NBDVPR=1,
NNUT=0,
NCPOUT=0,
NVLIN=1,
NTDAT=1, NCWT=4,
XM=16.8, ZM=0.0,
$END
      3      0      0
0.049692      0.0      0.0      -0.07889
0.049692 0.049692      0.0      -0.07889
0.049692 0.049692      0.0      -0.07889
      0      0      0      0
      0
ZZZZZZZZZZZZ

```

Figure 30.- Input of program DEMON2, second sample case, step 5.



## IDEALIZED LPC ELLIPTICAL BODY MONOPLANE WING

*INPUT		SREF	= .12547E+02,
CRD	= .754926E+01,	REFL	= .3444106E+01,
S*LEP	= .75E+02,	PHIOIH	= 0.0,
S*TED	= .5001560E+02,	THETIT	= 0.0,
NC*	= 2,	X*LE	= .18E+02,
MS+R	= 3,	NO*INP	= 1,
MS+L	= 0,	NO*UT	= 0,
ALFAC	= .1E+02,	NPR	= 0,
P*H	= 0.0,	NO*HAR	= 1,
H2	= .10435E+01,	NV*TX	= 0,
FMACH	= .17E+01,	N*PRESS	= 0,
LVS+D	= 0,	VOT*AX	= .35E+00,
FAC	= .95E+00,	NC*H	= 2,
NEV*DR	= 0,	NAG*IN	= 0,
TOLFAC	= .1E+01,	BIL	= .754926E+01,
MS+U	= 0,	ITAIL	= 0,
MS+D	= 0,	NV*TP*L	= 0,
S*LEV	= 0.0,	N*RDY*DR	= 1,
S*TEV	= 0.0,	V*DR	= 0,
CRPV	= 0.0,	N*TDAT	= 1,
QDV	= 0.0,	VC*WT	= 4,
N*CRV	= 0,	N*CP*OUT	= 0,
QR	= .3464106E+01,	V*LIN	= 1,
RA	= .11547005E+01,	X*START	= 0.0,
ERATIO	= .30000038471145E+01,	J*CT	= 0,
N*ROCK	= 14,	F*LE	= .5E+00,
DE*P	= 0.0,	F*SE	= .5E+00,
DE*LL	= 0.0,	X*	= .168E+02,
DE*LL	= 0.0,	Z*	= 0.0,
DE*LL	= 0.0,	SE*O	

Figure 31.- Output of program DEMON2, second sampel case, step 5.

# WING GEOMETRY

TIP CHORD = 4.09999

ROOT CHORD = 7.54926

WING SEMISPAN = 1.09350

LEADING EDGE SWEEP = 75.00000 DEGREES

TRAILING EDGE SWEEP = 30.01564 DEGREES

## FLOW CONDITIONS

MACH = 1.70000 ALPHAC = 10.00000 PHI = 0.00000 ALFA = 10.00000 BETA = 0.00000

CRPT = 7.54926

## WING THICKNESS INPUT DATA

SPANWISE LOCATIONS OF PANEL SIDE EDGES AND SWEEP ANGLES  
OF WING SECTION TO THE LEFT

I	SPANWISE LOCATION FEET	LE SWEEP DEGREES	TE SWEEP DEGREES
---	------------------------------	---------------------	---------------------

## RIGHT WING SURFACE

1	4.46411	0.00000	0.00000
2	3.82861	75.00000	30.01564
3	4.19311	75.00000	30.01564
4	4.55761	75.00000	30.01564

12 THICKNESS PANELS ARE TO BE LAID OUT  
3 CHORDWISE ROWS WITH 4 IN EACH ROW

INPUT VALUES OF THE LOCAL SURFACE SLOPE OF THE THICKNESS  
DISTRIBUTION. FOR EACH CHORDWISE ROW THE FIRST VALUE  
IS FOR THE PANEL NEAREST THE LEADING EDGE

## RIGHT WING SURFACE

ROW	SLOPES		
1	.04969	0.00000	0.00000
2	.04969	.04969	0.00000
3	.04969	.04969	0.00000

BODY UNDER CONSIDERATION HAS ELLIPTICAL CROSS SECTION.  
 INTERFERENCE SHELL HAS FOLLOWING PROPERTIES:  
 HORIZONTAL SEMI-AXIS = 1.46411  
 VERTICAL SEMI-AXIS = 1.15470

POINT COORDINATES AND PERTURBATION VELOCITIES CALCULATED BY PROGRAM VPATH OR VPATHL

IC	XCP	YCP	ZCP	VVEL(IC)	WVEL(IC)
1	21.98200	3.64130	0.00000	.22027E-01	-.73045E-01
2	25.47700	3.64130	0.00000	.23281E-01	-.74140E-01
3	22.79400	4.00490	0.00000	.32844E-01	-.48784E-01
4	25.71600	4.00490	0.00000	.34452E-01	-.41193E-01
5	23.60500	4.36790	0.00000	.32109E-01	-.21043E-01
6	25.95400	4.36790	0.00000	.33399E-01	-.22172E-01
7	21.58600	3.15540	.50368	.18131E+00	-.12374E+00
8	21.58600	1.67640	1.02370	.18057E+00	-.75801E-01
9	21.58600	.23983	1.16350	.11088E+00	-.10914E-01
10	21.58600	.23983	1.16350	.28788E-01	-.20990E-02
11	21.58600	.23983	-1.16350	-.52670E-03	-.37874E-04
12	21.58600	.79584	-1.16350	-.18287E-02	-.17394E-03
13	21.58600	1.67640	-1.02370	-.46457E-02	-.01224E-03
14	21.58600	3.15540	-.50368	-.21879E-01	-.17031E-01
15	25.36100	3.15540	.50368	.18992E+00	-.12949E+00
16	25.36100	1.67640	1.02370	.35303E+00	-.89873E-01
17	25.36100	.79584	1.16350	.11003E+00	-.10781E-01
18	25.36100	.23983	1.16350	.29018E-01	-.21119E-02
19	25.36100	.23983	-1.16350	-.57450E-03	-.01311E-04
20	25.36100	.79584	-1.16350	-.19440E-02	-.18974E-03
21	25.36100	1.67640	-1.02370	-.50641E-02	-.99439E-03
22	25.36100	3.15540	-.50368	-.23762E-01	-.18491E-01

CONTROL POINT COORDINATES FOR 2 CHORDWISE BY 3 SPANWISE PANELS ON WING 1 OR W, 0 SPANWISE ON WING 2 OR L  
 AND 0 SPANWISE PANELS ON WING 3 OR U, 0 SPANWISE ON WING 4 OR O

I	X(J)	Y(J)	Z(J)	RU(J)	RV(J)	RW(J)	VVRTX	WVRTX
1	3.98181	3.64135	0.00000	.40788E-01	-.38935E-01	.27791E+00	0.	0.
2	7.47690	3.64135	0.00000	.16709E-01	-.35151E-01	.20167E+00	0.	0.
3	4.79180	4.00486	0.00000	.28259E-01	-.33580E-01	.17286E+00	0.	0.
4	7.71557	4.00486	0.00000	.16194E-01	-.28395E-01	.14465E+00	0.	0.
5	5.60471	4.36789	0.00000	.26643E-01	-.31692E-01	.12540E+00	0.	0.
6	7.95193	4.36789	0.00000	.15490E-01	-.24185E-01	.11245E+00	0.	0.

CONTROL POINT COORDINATES FOR RTP'S (WING FRAME)

I	X(J)	Y(J)	Z(J)	THU(J)	THV(J)	THW(J)
7	3.58590	2.81795	.44979	-.14293F-02	-.50900E-02	.19263E-02
8	3.58590	1.63362	.99752	-.21755E-02	-.28706E-02	.14883E-02
9	3.58590	.74462	1.11965	0.	0.	0.
10	3.58590	.23690	1.14927	0.	0.	0.
11	3.58590	.23690	-1.14927	0.	0.	0.
12	3.58590	.74462	-1.11965	0.	0.	0.
13	3.58590	1.63362	-.99752	-.21755E-02	-.28706E-02	-.14883E-02
14	3.58590	2.81795	-.44979	-.14293F-02	-.50900E-02	-.19263E-02

Figure 31.- Continued.

15	7.36053	2.81795	.44979	.11729E-01	.12612E-01	-.75118E-02
16	7.36053	1.63362	.99752	-.17810E-02	-.42403E-02	.22634E-02
17	7.36053	.78442	1.11465	-.25780E-02	.13265E-02	.11738E-02
18	7.36053	.23690	1.14927	-.26999E-02	.79477E-03	.13010E-02
19	7.36053	.23690	-1.14427	-.26999E-02	.79477E-03	-.13010E-02
20	7.36053	.78442	-1.11965	-.25780E-02	.13265E-02	-.11738E-02
21	7.36053	1.63362	-.99752	-.17810E-02	-.42403E-02	.22634E-02
22	7.36053	2.81795	-.44979	.11729E-01	.12612E-01	.75118E-02

# LOADING INFORMATION

MACH NUMBER = .17000E+01  
 ANGLE OF ATTACK = 10.000 DEGREES  
 SIDE SLIP ANGLE = 0.000 DEGREES  
 WING AREA = 12.73846  
 REFERENCE AREA = 12.56700  
 REFERENCE LENGTH = 3.46411  
 EXPOSED WING SPAN H = 2.18700  
 MOMENT CENTER: XM = 16.80000  
 ZM = 0.60000

## WING TYPE LOADING PRESSURE

REFL. ANGLE DEG. =	TOTAL	FIN 1 OR R	FIN 2 OR L	FIN 3 OR U	FIN 4 OR D	INTERF. SHELL
CTHR =	.29818E+01	.10409E-01	.10409E-01	0.	0.	
CZ =	.47864E+00	.95932E-01	.95932E-01	0.	0.	.27878E+00
CY =	0.	0.	0.	0.	0.	0.
CM =	-.10223E+01	-.18717E+00	-.18717E+00	0.	0.	-.64798E+00
CLN =	0.	0.	0.	0.	0.	0.
CLL =	0.	-.10990E+00	.10990E+00	0.	0.	0.

## FOLLOWING ARE IN WIND-AXIS SYSTEM

CL =	.46711E+00	.96282E-01	.96282E-01	0.	0.	.27454E+00
CY+IND =	0.	0.	0.	0.	0.	0.
COY =	.61224E-01	.64074E-02	.64074E-02	0.	0.	.48410E-01
COZ/CL**2 =	.28080E+00					
CM+IND =	-.10223E+01	-.18717E+00	-.18717E+00	0.	0.	-.64798E+00
CL+IND =	0.	.19084E-01	-.19084E-01	0.	0.	0.

7.  $\frac{1}{2} \frac{d}{dt} \left( \frac{1}{2} \frac{d^2}{dt^2} \right) = \frac{1}{2} \frac{d^3}{dt^3}$

T	Y/(H/2)	CN/C/(2+3)	CT/C/(2+4)	CV1/C/(2+4)	CVTH1/C/(2+4)	CS/C/(2+8)	CSIN1	SPAR	GAMNET(1)	GAMNA,LE/VINF	XLE
1	3,32999	,27942	,02264	,06378	,02942	,08743	,03196	3,64135	,61334	,19406	,06148
2	3,66242	,27199	,02547	,07117	,09879	,09843	,06782	3,83365	,01657	,19763	2,01812
3	3,99441	,20436	,03423	,10075	,10075	,13225	,11602	4,05562	,14759	,21123	3,37295
4	4,16791	,0,00000							,48919		

SUMFY 2 = .10452E-01  
SUMFY1 = .29902E-01  
SUMFY2 = -.85395E-03  
SUMF12 = .10511E+00

### SIDE EDGE DISTRIBUTION

JTID	JSP	DISTANCE FROM LE / TIPCHORD	SUCTION FORCE PER UNIT LENGTH /(D* TIPCHORD)	GAWA, SP / VWF	YWR	YSE
1	1	.50000	.09399	.35606	4.36126	4.08100
2	2	1.00000	.06318	.47179	4.41828	6.13099

\*\*\*\*\* FIN VORTEX INFORMATION \*\*\*\*\*

IVPT GAMMA/VINE Y,C,G.

1 61196 4,44912

## VELOCITIES AND BERNOULLI PRESSURES AT CONTROL POINTS IMMEDIATELY ABOVE AND BELOW HORIZONTAL WING SURFACE

	X(J)	Y(J)	Z(J)	WTOT	VTOT	WTOT	PRESS	WTOT	VTOT	WTOT	PRESS
1	3.981812	3.641349	0.000000	.779046	-.240441	-.173648	-.145036	-.028511	.160947	-.173648	.062203
2	7.074991	3.641349	0.000000	.907994	-.025306	-.252538	-.145974	.000003	.121077	-.094758	.009207
3	4.703803	4.004860	0.000000	.074117	-.274844	-.123956	-.180059	-.072305	.282574	-.221348	.090370
4	7.715573	0.004460	0.000000	.062914	-.027248	-.252538	-.097007	.069095	.068748	-.094758	-.001914
5	4.804708	4.367885	0.000000	.115213	-.318455	-.123956	-.249191	.055108	.317540	-.223308	.033511
6	7.953725	4.367885	0.000000	.037632	-.043340	-.252538	-.050939	.016447	.082211	-.094758	-.004733

Figure 31.- Continued.

# CROSS-REF LOADINGS AT CONTROL POINTS

	X(J)	Y(J)	Z(J)	DELTP, LIN.	DELTP, REF.
1	3.941812	3.641349	0.000000	.215114	.227239
2	7.476901	3.441349	0.000000	.135861	.115181
3	4.793803	4.004860	0.000000	.300845	.270421
4	7.715573	4.004860	0.000000	.107659	.095088
5	5.604704	4.367885	0.000000	.341043	.282701
6	7.953925	4.367885	0.000000	.041370	.041200

## LOADING INFORMATION

MACH NUMBER = .17000E+01  
 ANGLE OF ATTACK = 10.000 DEGREES  
 SIDE SLIP ANGLE = 0.000 DEGREES  
 WING AREA = 12.75844  
 REFERENCE AREA = 12.56700  
 REFERENCE LENGTH = 3.46011  
 EXPOSED WING SPAN H = 2.16700  
 MOMENT CENTER: XM = 14.80000  
 ZM = 0.00000

## PERNOUITTI TYPE LOADING PRESSURE

	TOTAL	FIN 1 OR R	FIN 2 OR L	FIN 3 OR U	FIN 4 OR D	INTERF. SHELL
DEFL. ANGLE DEG.		0.00000	0.00000	0.00000	0.00000	
CTHR	.18690E-01	.94469E-02	.94469E-02	0.	0.	
CZ	.45372E+00	.87468E-01	.87468E-01	0.	0.	.27878E+00
CY	0.	0.	0.	0.	0.	0.
CM	.98554E+00	.16879E+00	.16879E+00	0.	0.	.64798E+00
CLN	0.	0.	0.	0.	0.	0.
CLL	0.	.99789E-01	.99789E-01	0.	0.	0.

## FOLLOWING ARE IN WIND-AXIS SYSTEM

CL	.45010E+00	.87779E-01	.87779E-01	0.	0.	.27454E+00
CY*IND	0.	0.	0.	0.	0.	0.
CDI	.40180E-01	.58852E-02	.58852E-02	0.	0.	.48410E-01
CDI/CL*+2	.29705E+00					
CM*IND	.98554E+00	.16879E+00	.16879E+00	0.	0.	.64798E+00
CLN*IND	0.	.17328E-01	.17328E-01	0.	0.	0.

Figure 31.- Continued.

-----RIGHT WING-----

# SPANNISE DISTRIBUTIONS

T	Y/(R/P)	CX=C/(2*H)	CT=C/(2*H)	CY1=C/(2*H)	CY1DT=C/(2*H)	CS=C/(2*H)	CSINT	YBAR	GAMNET(T)	GAMMA,LE/VINF	XLE
1	3.32000	.27500	.02356	.06693	.07818	.09105	.03319	3.64135	.59819	.20163	.66148
2	3.66242	.24316	.02286	.06392	.06174	.06833	.06538	3.82035	.06403	.19764	2.01812
3	3.99441	.17500	.02837	.06352	.06352	.10963	.10534	4.02805	.15351	.20115	3.37295
4	4.16791	0.00000							.38046		

SUMFY = .96890E+02  
 SUMFY1 = .27183E+01  
 SUMFY2 = .62412E+02  
 SUMFT2 = .87496E+01

## SIDE EDGE DISTRIBUTION

ITPT	JSE	DISTANCE FROM LE /TIPCHORD	SECTION FORCE PER UNIT LENGTH /(G*TIPTCHORD)	GAMMA,SE /VINF	YBAR	XSE
1	1	.50000	.07791	.31494	4.33889	4.08100
2	2	1.00000	.05351	.41103	4.40173	6.13099

\*\*\*\*\*E. FIN VORTEX INFO\*\*\*\*\*

1/RT GAMMA/VINF Y.C.G.

1 .59700 4.48465

\*\*\*\*\*  
 AFT OF LEADING EDGE OF FIN ROOTCHORDS

## PRESSURE COEFFICIENTS AT POINTS ON BODY MERIDIANS

J	THETA, DEG.	YR	YR	ZR	DTOT	VTOT	WTOT	CP,LIN.	CP,HERN.	OR/DX	P/PINF, BERN.	P/PINF, LIN.
---	----------------	----	----	----	------	------	------	---------	----------	-------	------------------	-----------------

Figure 31.- Continued.

BODY RING# 1												
1	11,25000	21,58490	2,81795	,44979	,03566	-.15872	-.07273	-.07133	-.07258	0,00000	,85317	,85570
2	33,75000	21,58490	1,63362	,99752	,04018	,25728	-.25096	-.04036	-.11227	0,00000	,77289	,83743
3	56,25000	21,58490	,78462	1,11965	,04365	,06333	-.19724	-.08730	-.05954	0,00000	,87956	,82340
4	78,75000	21,58490	,23690	1,14927	,04888	,01555	-.19731	-.09777	-.06592	0,00000	,86665	,80222
5	281,25000	21,58490	,23690	-1,14927	,02438	,02071	-.15369	-.04675	-.01705	0,00000	,96551	,90542
6	303,75000	21,58490	,78462	-1,11965	,04090	,08727	-.12762	-.08980	-.06656	0,00000	,86534	,81833
7	326,25000	21,58490	1,63362	-.99752	,02139	,11089	-.12188	-.04278	-.02688	0,00000	,94583	,91345
8	348,75000	21,58490	2,81795	-.44979	,03800	,26433	-.09288	-.07599	-.16311	0,00000	,67003	,84627

BODY RING# 2												
1	11,25000	25,36053	2,81795	,44979	,04331	-.11684	-.00815	-.08663	-.09132	0,00000	,81526	,82475
2	33,75000	25,36053	1,63362	,99752	,04291	,24035	-.25555	-.08502	-.14983	0,00000	,77751	,82801
3	56,25000	25,36053	,78462	1,11965	,07093	,10105	-.20891	-.14186	-.11497	0,00000	,76741	,71302
4	78,75000	25,36053	,23690	1,14927	,06584	,03170	-.20739	-.13169	-.09814	0,00000	,80146	,73360
5	281,25000	25,36053	,23690	-1,10927	,04033	,02233	-.13906	-.08866	-.05820	0,00000	,88227	,82064
6	303,75000	25,36053	,78462	-1,11965	,04190	,08776	-.13315	-.12480	-.09722	0,00000	,80332	,74955
7	326,25000	25,36053	1,63362	-.99752	,03614	,11786	-.11359	-.07232	-.05733	0,00000	,88402	,85349
8	348,75000	25,36053	2,81795	-.44979	,02213	,24577	-.19245	-.04425	-.17885	0,00000	,63819	,91047

Figure 31.- Concluded.



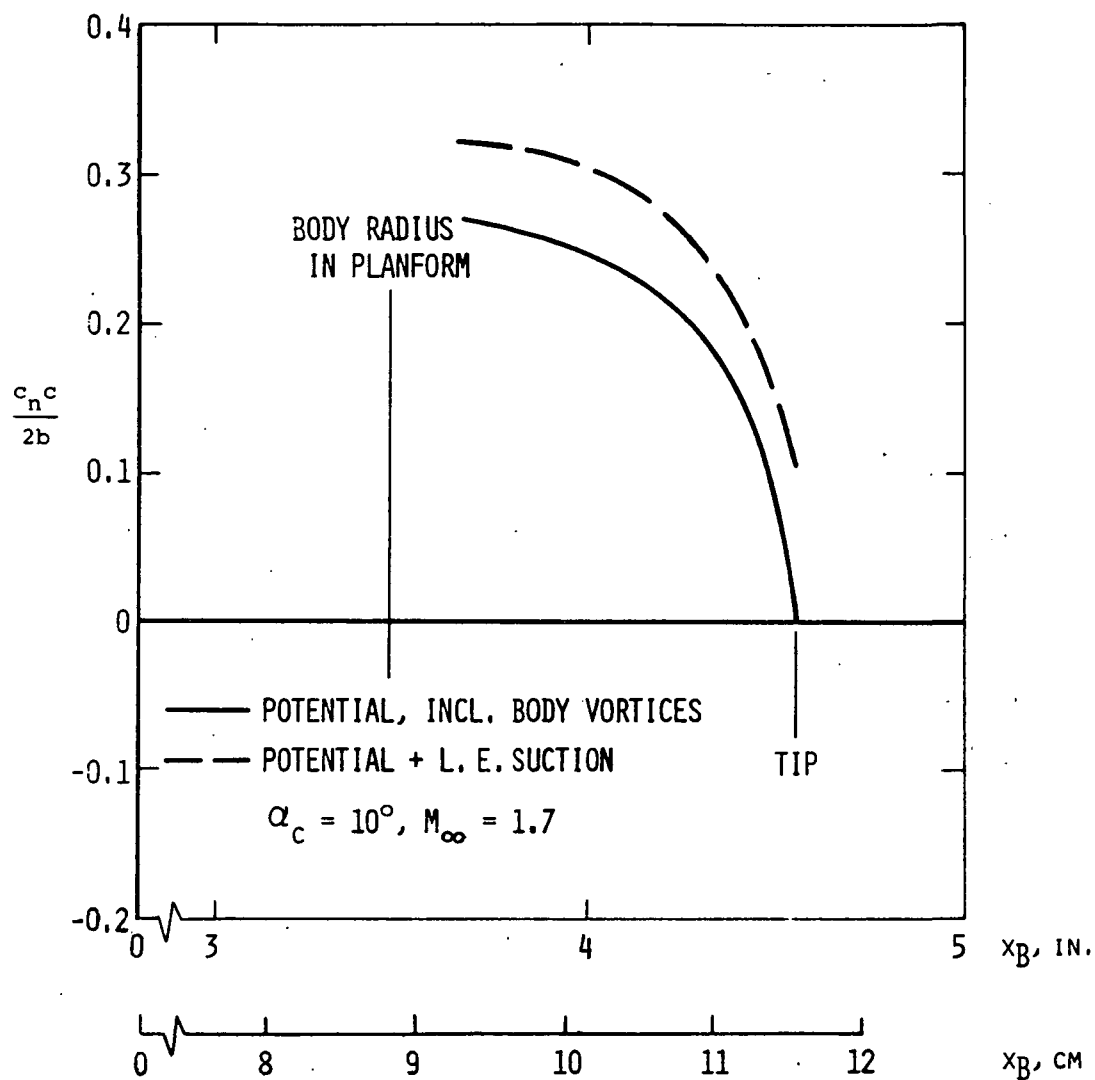


Figure 32.- Calculated span-load distribution on monoplane wing, second sample case.

# IDEALIZED LRC ELLIPTICAL BODY-INTERDIGITATED FIN8.

SINPUT

CRP=3.6, B2=3.6, CRPV=3.6, B2V=3.6, NCRX=1,

BIL=3.6, RB=3.129, RA=1.043,

PHIDIH=30., THETIT=22.545,

XWLE=24.4,

NCW=2, MSWR=4, MSWU=4, NBDIC=8, NCWB=2,

NBDIC=16,

ALFAC=10.0, FMACH=1.7, PHIM=0.,

SREF=12.567, REFL=3.464106,

NVRTX=6,

LVSWP=1, NOLINP=1,

NDUT=0,

NBDYPR=1,

NDRAG=0,

XM=16.8, ZM=0.0,

SEND

0.0	45.0	0.0
-----	------	-----

1.0	45.0	0.0
-----	------	-----

2.0	45.0	0.0
-----	------	-----

3.0	14.03624	0.0
-----	----------	-----

3.6	14.03624	0.0
-----	----------	-----

0.0	45.0	0.0
-----	------	-----

1.0	45.0	0.0
-----	------	-----

2.0	45.0	0.0
-----	------	-----

3.0	14.03624	0.0
-----	----------	-----

3.6	14.03624	0.0
-----	----------	-----

1.52	2.4609	1.8809
------	--------	--------

-1.52	-2.4609	1.8809
-------	---------	--------

0.47179	4.41828	0.661
---------	---------	-------

-0.47179	-4.41828	0.661
----------	----------	-------

0.59704	4.38465	0.0
---------	---------	-----

-0.59704	-4.38465	0.0
----------	----------	-----

0	0
---	---

0

ZZZZZZZZZZ

Figure 33.- Input of program DEMON2, second case, step 10.

IDEALIZED LRC ELLIPTICAL HOBY-INTERDIGITATED FINS.  
SIAPUT

CRP = .36E+01,

S-LEP = 0.0,

S-TEP = 0.0,

NCN = 2,

MSWR = 4,

MSWL = 0,

ALFAC = .1E+02,

PHI = 0.0,

B2 = .36E+01,

FMACH = .17E+01,

LVS-P = 1,

FAC = .95E+00,

NFVNPR = 0,

TOLFAC = .1E+01,

MSWU = 4,

MSWD = 0,

S-LEV = 0.0,

S-TEV = 0.0,

CRPV = .36E+01,

B2V = .36E+01,

NCPX = 1,

RS = .3129E+01,

RA = .1043E+01,

ERATIO = .3E+01,

NBOCB = 16,

DELR = 0.0,

DELL = 0.0,

DELU = 0.0,

DELD = 0.0,

SREF = .12567E+02,

REFL = .344410E+01,

PHIDIM = .3E+02,

T-FYIT = .22545E+02,

X-LE = .244E+02,

NOLIP = 1,

NOUT = 0,

NPR = 0,

NPRAG = 0,

NVRTX = 6,

NPRESS = 0,

VHTMAX = .35E+00,

NCWB = 2,

NAGAIN = 0,

BIL = .36E+01,

ITAIL = 0,

NVTPL = 0,

NBYPRV = 1,

NTPR = 0,

NTDIT = 0,

NCWT = 0,

NCPOUT = 0,

NVITN = 0,

XSTART = 0.0,

JCPT = 0,

FKLE = .5E+00,

FKSF = .5E+00,

XM = .166E+02,

XM = 0.0,

SEND

Figure 34.- Output of program DEMON2, second sample case, step 10.

# WING 1 SURFACE

## SPECIFIED SPANWISE LOCATIONS OF OUTBOARD PANEL EDGES AND SWEEP ANGLES

K	X OR Z	L.E. SWEEP ANGLE	T.E. SWEEP ANGLE
1	0.00000	45.00000	0.00000
2	1.00000	45.00000	0.00000
3	2.00000	45.00000	0.00000
4	3.00000	14.03624	0.00000
5	3.60000	14.03624	0.00000

# WING 3 SURFACE

1	0.00000	45.00000	0.00000
2	1.00000	45.00000	0.00000
3	2.00000	45.00000	0.00000
4	3.00000	14.03624	0.00000
5	3.60000	14.03624	0.00000

# WING GEOMETRY

TIP CHORD = 1.20000  
 ROOT CHORD = 3.60000  
 WING SEMISPAN = 3.60000

# FLOW CONDITIONS

MACH = 1.70000    ALPHAM = 10.00000    PHI = 0.00000    ALFA = 10.00000    BETA = 0.00000

CRPT = 3.60000  
 CRPTV = 3.00000

BODY UNDER CONSIDERATION HAS ELLIPTICAL CROSS SECTION.  
 INTERFERENCE SHELL HAS FOLLOWING PROPERTIES:  
 HORIZONTAL SEMI-AXIS = 3.12900  
 VERTICAL SEMI-AXIS = 1.04300

## TWO DIMENSIONAL VORTEX STRENGTHS AND FIXED COORDINATES IN CROSS FLOW PLANE

IVRTX	GAMMA/VINF	VVRTX	ZVRTX
1	1.52000	2.46090	1.88090
2	-1.52000	-2.46090	1.88090
3	.47179	4.41828	.66100
4	-.47179	-4.41828	.66100
5	.59704	4.38465	0.00000
6	-.59704	-4.38465	0.00000

CONTROL POINT COORDINATES FOR 2 CHORDWISE BY 4 SPANWISE PANELS ON WING 1 OR R. 0 SPANWISE ON WING 2 OR L  
AND 4 SPANWISE PANELS ON WING 3 OR U. 0 SPANWISE ON WING 4 OR D

J	X(J)	Y(J)	Z(J)	HU(J)	HV(J)	HW(J)	VVRTX	WVRTX
1	1.95839	2.36879	1.04983	-.22304E-01	-.27928E+00	-.24470E-01	.35000E+00	-.16737E+00
2	3.52183	2.36879	1.04983	-.99857E-02	-.21752E+00	-.13710E-01	.35000E+00	-.16737E+00
3	2.47667	3.22373	1.54343	-.35266E-02	-.12948E+00	.35743E-01	.14981E+00	.90173E-01
4	3.54651	3.22373	1.54343	-.37760E-01	-.92972E-01	.72383E-01	.14981E+00	.90173E-01
5	2.82377	4.11189	2.05621	.49070E-02	-.83780E-01	.30039E-01	-.44104E-01	.38832E-01
6	3.54304	4.11189	2.05621	.49493E-02	-.77348E-01	.30450E-01	-.44104E-01	.38832E-01
7	2.92985	4.81185	2.46033	.11607E-01	-.62414E-01	.21053E-01	-.52146E-01	.36886E-01
8	3.56809	4.81185	2.46033	.10375E-01	-.61533E-01	.22700E-01	-.52146E-01	.36886E-01
9	1.95839	2.36879	-1.04983	.66523E-01	.18515E+00	.39039E-01	-.56348E-01	-.49656E-01
10	3.52183	2.36879	-1.04983	.16705E-01	.18064E+00	.86807E-02	-.56348E-01	-.49656E-01
11	2.47667	3.22373	-1.54343	.46936E-01	.76537E-01	.78011E-01	.57644E-02	-.82758E-01
12	3.54651	3.22373	-1.54343	.45037E-01	.65613E-01	.78516E-01	.57644E-02	-.82758E-01
13	2.82377	4.11189	-2.05621	.18352E-01	.54070E-01	.53548E-01	.43949E-01	-.47547E-01
14	3.54304	4.11189	-2.05621	.33221E-01	.32119E-01	.60967E-01	.43949E-01	-.47547E-01
15	2.92985	4.81185	-2.46033	.19116E-01	.32005E-01	.44612E-01	.43341E-01	-.22704E-01
16	3.56809	4.81185	-2.46033	.17010E-01	.32982E-01	.43647E-01	.43341E-01	-.22704E-01

## CONTROL POINT COORDINATES FOR BIP-B (WING FRAME)

J	X(J)	Y(J)	Z(J)	THU(J)	THV(J)	THW(J)
17	1.71000	2.90725	.26764	0.	0.	0.
18	1.71000	2.32228	.67428	0.	0.	0.
19	1.71000	1.31938	.91568	0.	0.	0.
20	1.71000	.33985	1.03055	0.	0.	0.
21	1.71000	.33985	-1.03055	0.	0.	0.
22	1.71000	1.31938	-.91568	0.	0.	0.
23	1.71000	2.32228	-.67428	0.	0.	0.
24	1.71000	2.90725	-.26764	0.	0.	0.
25	3.51000	2.90725	.26764	0.	0.	0.
26	3.51000	2.32228	.67428	0.	0.	0.
27	3.51000	1.31938	.91568	0.	0.	0.
28	3.51000	.33985	1.03055	0.	0.	0.
29	3.51000	.33985	-1.03055	0.	0.	0.
30	3.51000	1.31938	-.91568	0.	0.	0.
31	3.51000	2.32228	-.67428	0.	0.	0.
32	3.51000	2.90725	-.26764	0.	0.	0.

Figure 34.- Continued.

# LOADING INFORMATION

MACH NUMBER ■ .17000E+01  
 ANGLE OF ATTACK ■ 10.000 DEGREES  
 SIDE SLIP ANGLE ■ 0.000 DEGREES  
 WING AREA ■ 14.88000  
 REFERENCE AREA ■ 12.56700  
 REFERENCE LENGTH ■ 3.46411  
 EXPOSED WING SPAN ■ 7.20000  
 MOMENT CENTER: XM ■ 16.80000  
 ZM ■ 0.00000

## U/VINE TYPE LOADING PRESSURE

REFL. ANGLE DEG. ■	TOTAL	FIN 1 OR R	FIN 2 OR L	FIN 3 OR U	FIN 4 OR O	INTERF. SHELL
CTHR ■ 0.	0.	0.00000	0.00000	0.00000	0.00000	
CZ ■ .79276E+00	.15866E+00	.28077E+00	.28077E+00	.15866E+00	.15866E+00	-.86142E-01
CY ■ .04409E+15	-.91614E-01	-.16210E+00	-.16210E+00	-.91614E-01	-.91614E-01	0.
CM ■ -.24354E+01	-.49867E+00	-.84948E+00	-.84948E+00	-.49867E+00	-.49867E+00	.26055E+00
CLN ■ .17764E-14	.28791E+00	.49044E+00	.49044E+00	.28791E+00	.28791E+00	0.
CLL ■ 0.	-.23775E+00	.33936E+00	.33936E+00	-.23775E+00	-.23775E+00	0.

## FOLLOWING ARE IN WIND-AXIS SYSTEM

CL ■ .78071E+00	.15627E+00	.27650E+00	.27650E+00	.15627E+00	-.84834E-01
CY=IND ■ .04409E-15	-.91614E-01	-.16210E+00	-.16210E+00	-.91614E-01	0.
CDI ■ .13766E+00	.27554E-01	.48755E-01	.48755E-01	.27554E-01	-.14058E-01
CDI/CL*2 ■ .22545E+00					
CM=IND ■ -.24354E+01	-.49867E+00	-.84948E+00	-.84948E+00	-.49867E+00	.26055E+00
CLN=IND ■ -.17764E-14	.32482E+00	.42406E+00	.42406E+00	.32482E+00	0.

NOTE: L.E. OF LEAD PANEL IN FIRST CHORDWISE ROW IS SUPERSONIC

Figure 34.- Continued.

PRESSURE LOADINGS EXCLUDE VORTEX INDUCED COMPONENTS PARALLEL TO WING SURFACES

## VELOCITIES AND BERNOULLI PRESSURES AT CONTROL POINTS IMMEDIATELY ABOVE AND BELOW HORIZONTAL WING SURFACE

J	X(J)	Y(J)	Z(J)	UTOTA	VTOTA	WTOTA	PRESSA	UTOTB	VTOTB	WTOTB	PRESSB
1	1.958387	2.368794	1.049832	-.060417	-.244603	-.114140	-.095448	-.039836	-.222632	-.114140	-.095567
2	3.521828	2.368794	1.049832	-.029305	-.204153	-.124938	-.069335	-.039318	-.249308	-.124818	-.042954
3	2.476667	3.223734	1.543432	-.121688	-.143424	-.148312	-.205019	-.103367	-.143647	-.148312	-.232944
4	3.546508	3.223734	1.543432	-.003099	-.029810	-.099819	-.016312	-.159358	-.094485	-.099819	-.374784
5	2.823771	4.111893	2.056211	-.213850	-.015533	-.194012	-.316096	-.196036	-.143093	-.194012	-.438050
6	3.563037	4.111893	2.056211	-.189108	-.009019	-.198712	-.286204	-.153581	-.192393	-.198712	-.528900
7	2.929853	4.811851	2.460332	-.199154	-.047522	-.188801	-.299563	-.175940	-.172350	-.188801	-.394577
8	3.568088	4.811851	2.460332	-.142559	-.029981	-.184547	-.222648	-.121809	-.153047	-.184547	-.273116

## VELOCITIES AND BERNOULLI PRESSURES AT CONTROL POINTS IMMEDIATELY TO RIGHT AND LEFT OF VERTICAL WING SURFACE

J	X(J)	Y(J)	Z(J)	UTOTR	VTOTR	WTOTR	PRESSR	UTOTL	VTOTL	WTOTL	PRESSL
9	1.958387	2.368794	-1.049832	-.044991	-.168237	-.373959	-.175641	-.249192	-.148237	-.031052	-.372582
10	3.521828	2.368794	-1.049832	-.044396	-.140092	-.362762	-.166626	-.138546	-.140092	-.071779	-.265562
11	2.476667	3.223734	-1.543432	-.101947	-.198473	-.294348	-.027210	-.243875	-.198473	-.062978	-.369046
12	3.546508	3.223734	-1.543432	-.056798	-.131307	-.209349	-.024477	-.168714	-.131307	-.058905	-.276415
13	2.823771	4.111893	-2.056211	-.136484	-.003334	-.191478	-.163305	-.173188	-.003334	-.145856	-.265484
14	3.563037	4.111893	-2.056211	-.129189	-.048806	-.262599	-.079400	-.239683	-.048806	-.158975	-.345343
15	2.929853	4.811851	-2.460332	-.125169	-.018274	-.196437	-.135183	-.163401	-.018274	-.168646	-.251941
16	3.568088	4.811851	-2.460332	-.048420	-.012932	-.152513	-.095937	-.122440	-.012932	-.124693	-.193134

## PRESSURE LOADINGS AT CONTROL POINTS

J	X(J)	Y(J)	Z(J)	DELTP,LTN.	DELTP,HEMN.
1	1.958387	2.368794	1.049832	-.708505	-.191011
2	3.521828	2.368794	1.049832	-.137247	-.112289
3	2.476667	3.223734	1.543432	-.450110	-.437964
4	3.546508	3.223734	1.543432	-.324916	-.358472
5	2.823771	4.111893	2.056211	-.819773	-.754146
6	3.563037	4.111893	2.056211	-.685458	-.615104
7	2.929853	4.811851	2.460332	-.750189	-.694140
8	3.568088	4.811851	2.460332	-.528737	-.495764
9	1.958387	2.368794	-1.049832	-.896145	-.196941
10	3.521828	2.368794	-1.049832	-.365964	-.098936
11	2.476667	3.223734	-1.543432	-.691645	-.341835
12	3.546508	3.223734	-1.543432	-.451023	-.251738
13	2.823771	4.111893	-2.056211	-.619343	-.428789
14	3.563037	4.111893	-2.056211	-.737743	-.424743
15	2.929853	4.811851	-2.460332	-.577138	-.387123
16	3.568088	4.811851	-2.460332	-.421718	-.289071

Figure 34.- Continued.

# LOADING INFORMATION

MACH NUMBER = .17000E+01  
 ANGLE OF ATTACK = 10.000 DEGREES  
 SIDE SLIP ANGLE = 0.000 DEGREES  
 WING AREA = 14.0000  
 REFERENCE AREA = 12.56700  
 REFERENCE LENGTH = 3.46411  
 EXPOSED WING SPAN H = 7.20000  
 MOMENT CENTER: XM = 14.00000  
 ZM = 0.00000

## BERNOULLI TYPE LOADING PRESSURE

REFL. ANGLE DEG.	TOTAL	FIN 1 OR R	FIN 2 OR L	FIN 3 OR U	FIN 4 OR D	INTERF. SHELL
CTHR = 0.	0.	0.00000	0.00000	0.00000	0.00000	0.
CZ = .48572E+00	.15017E+00	.13574E+00	.13574E+00	.13574E+00	.15017E+00	-.86147E-01
CY = 0.	-.86703E-01	-.78379E-01	-.78379E-01	-.78379E-01	-.86703E-01	0.
CM = -.15093E+01	-.47164E+00	-.41326E+00	-.41326E+00	-.41326E+00	-.47164E+00	-.26055E+00
CLN = 0.	.27232E+00	.23859E+00	.23859E+00	.23859E+00	.27232E+00	0.
CLL = 0.	-.22411E+00	.17658E+00	.17658E+00	.17658E+00	.22411E+00	0.

## FOLLOWING ARE IN WIND-AXIS SYSTEM

CL = .47434E+00	.14749E+00	.13369E+00	.13369E+00	.14749E+00	-.84834E-01
CY-IND = 0.	-.86703E-01	-.78379E-01	-.78379E-01	-.86703E-01	0.
CDI = .84344E+01	.26074E-01	.23574E-01	.23574E-01	.26074E-01	-.14955E-01
CNT/CL**2 = .36862E+00					
CM-IND = -.15093E+01	-.47164E+00	-.41326E+00	-.41326E+00	-.47164E+00	-.26055E+00
CLN-IND = 0.	.30710E+00	.20431E+00	.20431E+00	.30710E+00	0.

NOTE: C.E. OF LEAD PANEL IN FIRST CHORDWISE ROW IS SUPERSONIC

\*\*\*\*\*  
 APT OF LEADING EDGE OF FIN BOOTCHORDS



## PRESSURE COEFFICIENTS AT PRINTS ON BODY MERIDIANS

J	THETA, DEG.	XB	YB	ZB	UTOT	VTOT	WTOT	CP,LIN.	CP,HEMN.	RR/DX	P/PINF. HEMN.	P/PINF. LIN.
BODY RING# 1												
1	5,63625	26,11000	2,90725	,26764	,06124	-,00056	-,06231	-,00247	-,01547	0,00000	1,03129	,99500
2	16,90875	26,11000	2,32228	,67428	,02845	-,06340	-,18355	-,05691	-,03014	0,00000	,93903	,89047
3	50,63625	26,11000	1,31938	,91568	-,03987	,14164	-,18516	,07973	,09247	0,00000	1,18768	1,16130
4	84,36375	26,11000	,33985	1,03055	,01402	,00238	-,21697	-,02983	-,00133	0,00000	,99732	,93965
5	99,09125	26,11000	,33985	1,03055	,05001	,03787	-,14973	-,10182	-,07077	0,00000	,95684	,79402
6	331,81875	26,11000	1,31938	-,91568	,01217	,05166	-,13975	-,02435	-,00221	0,00000	1,00448	,95075
7	343,09125	26,11000	2,32228	-,67428	,23305	,00596	-,04719	-,46810	-,34416	0,00000	,30376	,05708
8	354,36375	26,11000	2,90725	-,26764	,11716	-,04363	-,05913	-,23432	-,19382	0,00000	,60789	,52597
BODY RING# 2												
1	5,63625	27,91000	2,90725	,26764	-,04536	,21072	-,21777	,09073	,07482	0,00000	1,15136	1,18354
2	16,90875	27,91000	2,32228	,67428	-,05142	-,01007	-,16570	,10365	,14193	0,00000	1,28712	1,20968
3	50,63625	27,91000	1,31938	,91568	-,02660	,13444	-,17723	,05321	,04675	0,00000	1,13504	1,10764
4	84,36375	27,91000	,33985	1,03055	-,04515	-,00781	-,19347	,09031	,12675	0,00000	1,25602	1,18269
5	99,09125	27,91000	,33985	1,03055	,00804	-,00849	-,14352	-,01149	-,01765	0,00000	1,01571	,97595
6	331,81875	27,91000	1,31938	-,91568	,00849	,02511	-,13126	-,01498	-,01191	0,00000	1,02228	,96564
7	343,09125	27,91000	2,32228	-,67428	,16337	,06735	-,04384	-,32673	-,28430	0,00000	,48532	,33902
8	354,36375	27,91000	2,90725	-,26764	,14197	-,06378	-,07977	-,28393	-,22945	0,00000	,53582	,47560

Figure 34.- Concluded.

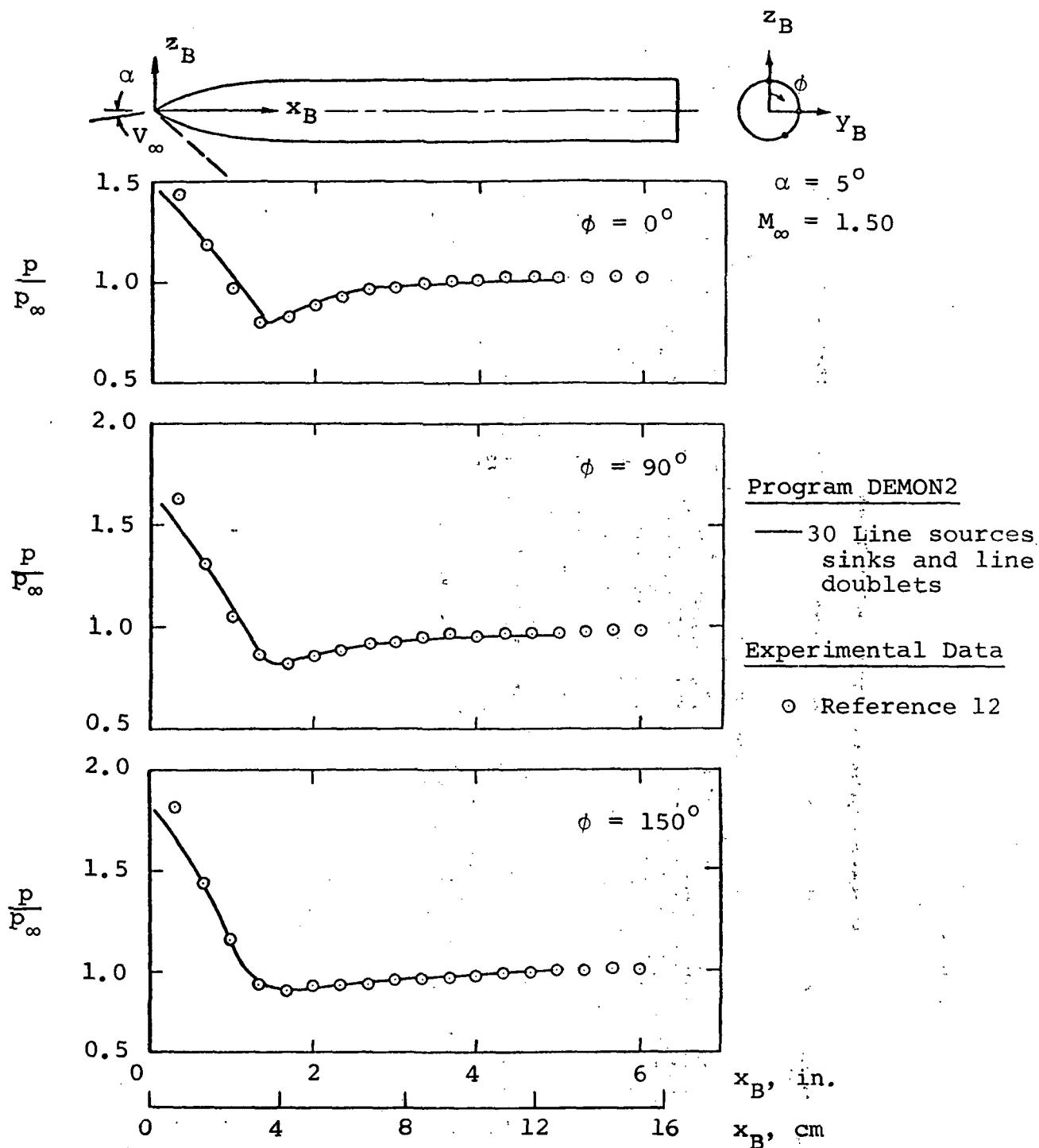


Figure 35.- Pressure distribution on ogive cylindrical body in uniform flow;  $M_\infty = 1.50$ .

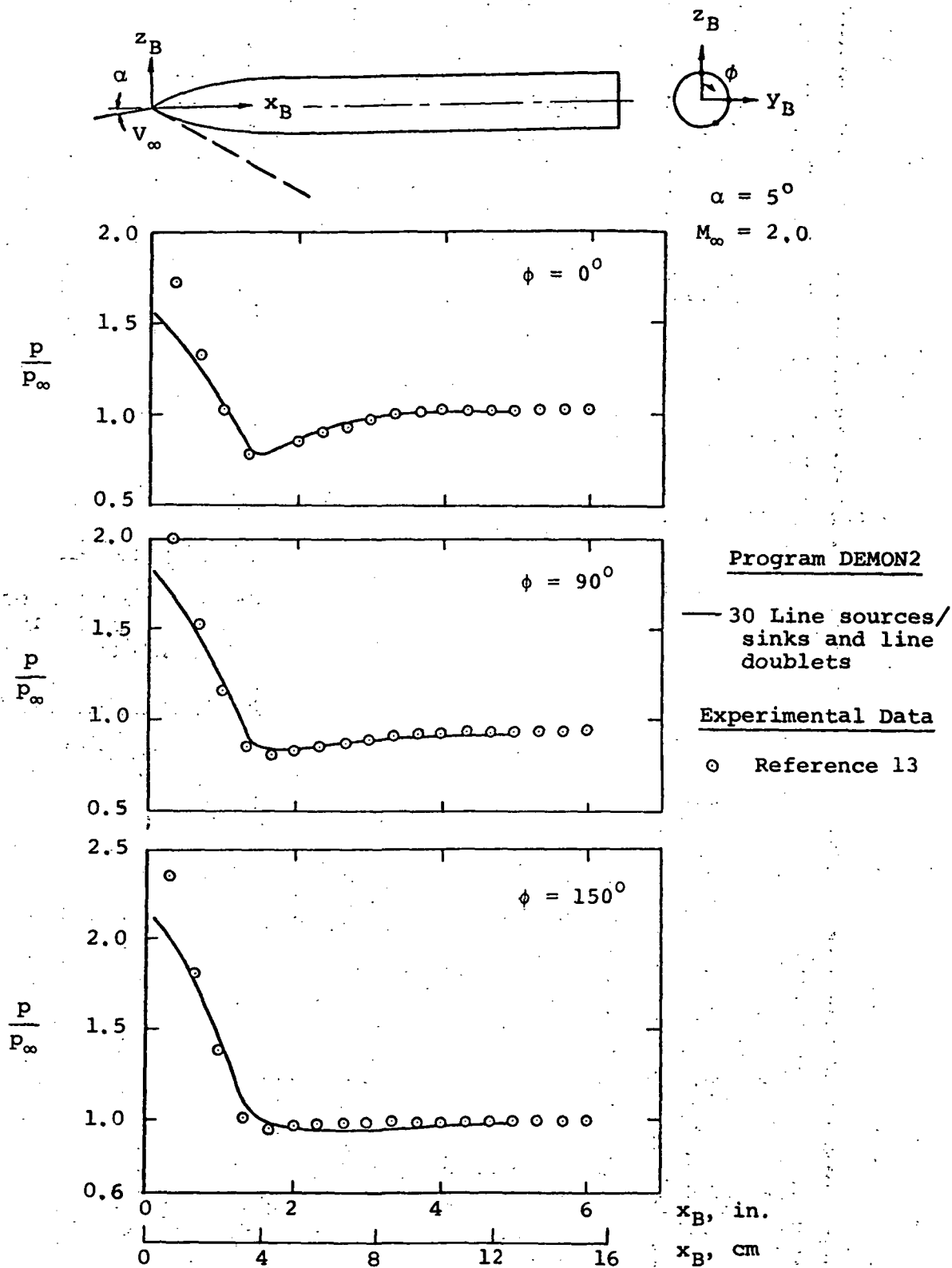
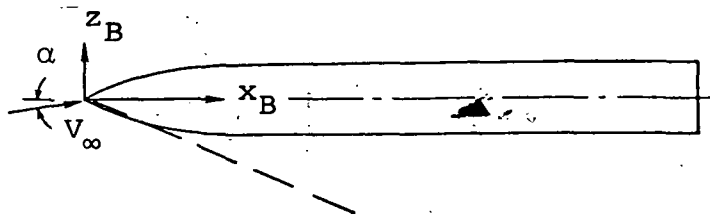
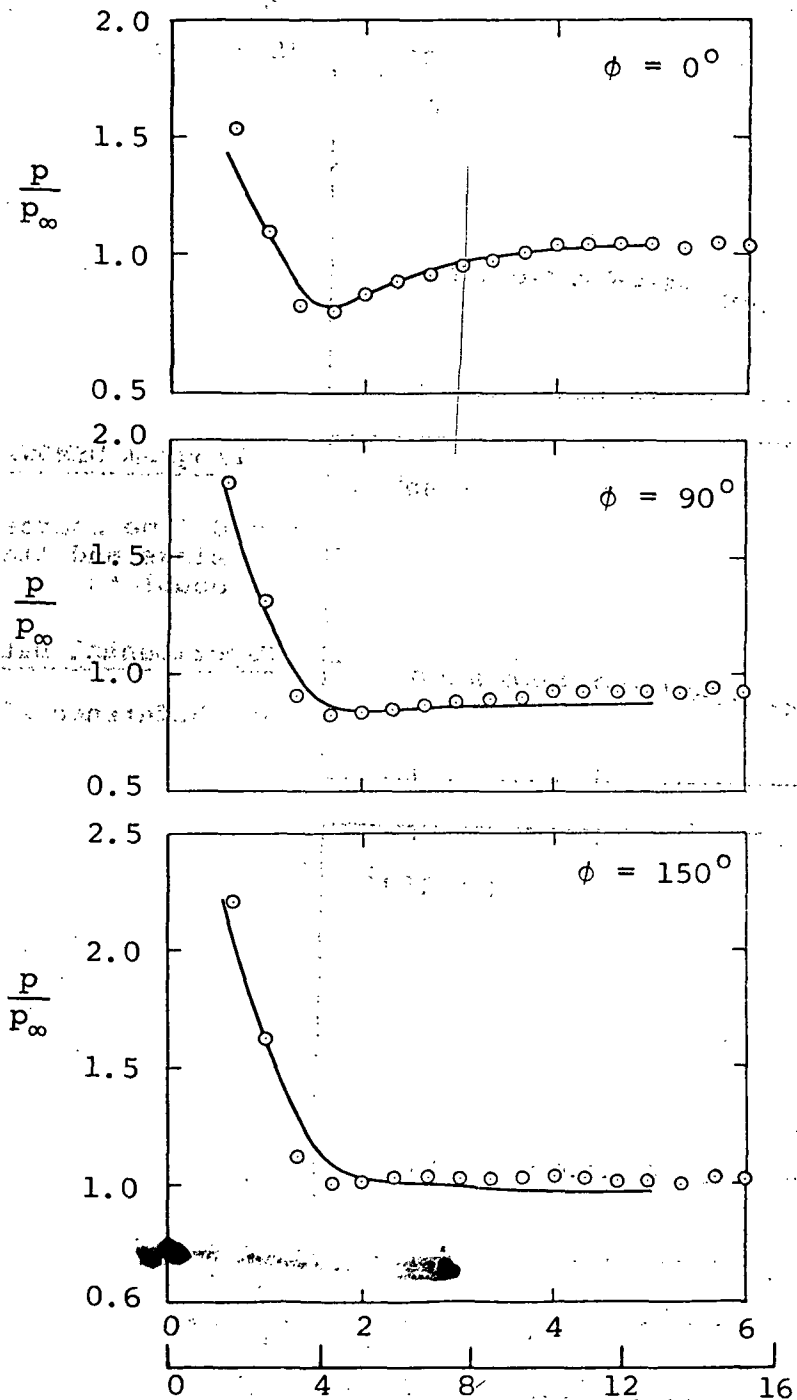


Figure 36.- Pressure distribution on ogive cylindrical body in uniform flow;  $M_\infty = 2.0$ .



$$\alpha = 5^\circ$$

$$M_\infty = 2.5$$



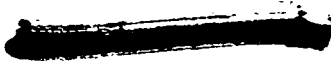
Program DEMON2

— 30 Line sources/  
sinks and line  
doublets

Experimental Data

○ Reference 14

Figure 37.- Pressure distribution on ogive cylindrical body in uniform flow;  $M_\infty = 2.5$ .

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